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ABSTRACT

This document contains a brief report describing the development of validated competency profiles for business, home economics, and industrial education at the University of Missouri-Columbia, as well as a set of the profiles. The profiles are used to evaluate students' levels of mastery of competencies in the content areas of each course. Two business education profiles are included: mathematics in business and business economics. Home economics profiles include the following: family/consumer resource management; family/individual health; nutrition and wellness; housing, home furnishings, and equipment; family living and parenthood; and child development, care, and guidance. Profiles for industrial education are as follows: drafting, electronics, machine tool technology, and welding. The industrial education profiles also include performance indicators for each topic--a crosswalk to selected instructional materials from the national skill standards, Missouri competencies, Show-Me Standards, All Aspects of Industry objectives, preemployment/work maturity skills, and Vocational Industrial Clubs of America/Secretary's Commission on Achieving Necessary Skills competencies. (YLB)

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ED 404 537

FINAL REPORT

Competency Profiles for Vocational Education

Project No. 95-133-110-3

JUNE 30, 1995

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FINAL REPORT

Competency Profiles for Vocational Education

(RFP 95-133-110-3)

Harley Schlichting, Project Director
University of Missouri-Columbia
Columbia, MO 65211

June 30, 1995

Missouri Department of Elementary and Secondary Education
Vocational Planning and Evaluation Unit
Jefferson City, MO 65102

ABSTRACT

Title:	competency profiles for vocational education (RFP 95-133-110-3)
Principal investigator:	Harley Schlichting, director, instructional materials laboratory
Institution:	university of Missouri-Columbia
Location:	Columbia, mo 65211
Phone:	314/882-2884
Starting/ending dates:	July 1, 1994, June 30, 1995

Objectives of the Project

To develop and print validated competency profiles to be utilized by the business education and industrial education programs.

1. Competency Profile for Business Math
2. Competency Profile for Economics
3. Competency Profile for Competency-Based Scope and Sequence for Vocational Home Economics Programs in Missouri
4. Competency Profile for Trade and Industrial Programs: Industrial Maintenance (new); Drafting (1990); Electronics (1986); Welding (1986); Machine Shop (1988).

A Brief Description of the Project

The number of copies prescribed in the Request for Proposals for each curriculum module will accompany this report to the Division of Vocational and Adult Education, Vocational Planning and Evaluation Section, by the scheduled completion date.

Impact Statement

Materials developed as a result of this project will be used by vocational educators in nearly 400 Missouri school districts, thus reaching thousands of vocational students throughout the state.

OBJECTIVES

Business Education - Business Math Profile

The overall goal of this project was to develop and print a validated Business Math competency profile to be utilized by the business education program. Successful completion of this goal depended on the completion of the following specific objectives.

1. Designate a project coordinator.
2. Establish an advisory committee representative of secondary and post-secondary math and business education teachers, teacher educators, and Department of Elementary and Secondary Education staff in consultation with DESE.
3. Review available course outlines, objectives and competencies developed from other states. Distribute copies to committee members for review prior to the meeting.
4. Conduct a one-day meeting with the advisory committee to develop the competency list for Business Math, using a modified DACUM process.
5. Edit, word process, and proofread the competency list, and send it to the committee for review.
6. Validate the competency list through mailings (at least 100) to business, industry, and education representatives.
7. Meet with representatives of the Business Math advisory committee and DESE to present the results of the validation process.
8. Finalize the Business Math competency profile in the same format as those previously developed through the Instructional Materials Laboratory at the University of Missouri-Columbia.
9. Conduct periodic reviews for Vocational Planning and Evaluation (VPE) supervisor and DESE program area director.
10. Print and deliver four copies of the final report and product to the Division of Vocational and Adult Education, Vocational Planning and Evaluation, no later that June 30, 1995.
11. Print and deliver 400 copies of the completed profiles to the Director of the Business Education Section of the Department of Elementary and Secondary Education for dissemination to vocational business teachers and teacher educators no later than June 30, 1995.

Business Education - Business Economics Profile

The overall goal of this project was to develop and print a validated Business Economics competency profile to be utilized by the business education program. Successful completion of this goal depended on the completion of the following specific objectives.

1. Designate a project coordinator.

2. Establish an advisory committee representative of secondary and post-secondary economics and business education teachers, teacher educators, and Department of Elementary and Secondary Education staff in consultation with DESE.
3. Review available course outlines, objectives and competencies developed from other states. Distribute copies to committee members for review prior to the meeting.
4. Conduct a one-day meeting with the advisory committee to develop the competency list for Business Economics, using a modified DACUM process.
5. Edit, word process, and proofread the competency list, and send it to the committee for review.
6. Validate the competency list through mailings (at least 100) to business, industry, and education representatives.
7. Meet with representatives of the Business Economics advisory committee and DESE to present the results of the validation process.
8. Finalize the Business Economics competency profile in the same format as those previously developed through the Instructional Materials Laboratory at the University of Missouri-Columbia.
9. Conduct periodic reviews for Vocational Planning and Evaluation (VPE) supervisor and DESE program area director.
10. Print and deliver four copies of the final report and product to the Division of Vocational and Adult Education, Vocational Planning and Evaluation, no later that June 30, 1995.
11. Print and deliver 400 copies of the completed profiles to the Director of the Business Education Section of the Department of Elementary and Secondary Education for dissemination to vocational business teachers and teacher educators no later than June 30, 1995.

Home Economics Education - Revise Competency Lists in Scope and Sequence

The general objective of this proposal was to revise, validate and disseminate competencies for six semester courses in consumer and homemaking education. Successful completion of this general objective depended upon the completion of the following specific objectives, which was done in cooperation with Home Economics Education staff, DESE.

1 Assign a coordinator for the project.

2 Organize three 12-member advisory committees, each consisting of:

- a Seven secondary consumer and homemaking education teachers
- b Three subject matter specialists and/or appropriate agencies
- c Two Home Economics Education, DESE, staff members

3 Conduct three (3) two-day meetings.

- a Use existing, validated competencies from Missouri and other states as resources, as well as the occupational analysis for the Missouri homemaker.

b Compile a draft list of revised competencies.

c Make sequencing changes to Missouri Homemaker Occupational Analysis, if needed.

4 Validate the revised competencies.

a Select 20 teachers to validate each competency list.

b Develop an appropriate evaluation instrument.

c Send mailings consisting of cover letter, evaluation instrument and draft list of revised competencies.

d Tabulate evaluation results.

e Make minor revisions, as needed, in cooperation with DESE staff.

5 Provide revised competencies and corresponding occupational analysis charts for DESE review and sign-off.

6 Print revised, validated competencies with corresponding Missouri Homemaker Occupational Analysis charts for insertion into *Competency-Based Scope and Sequence for Vocational Home Economics Programs in Missouri.* The revised pages will replace existing pages.

7 Provide 650 copies of printed material to Home Economics Education Director, DESE. With a cover letter from the Home Economics Education Section, this material will be mailed to each middle/junior/senior high school home economics department in Missouri.

Industrial Education - Competency Profile Update, Crosswalk to National Standards And Performance Objective Development

The overall goal of the project discussed in this proposal was threefold. First, the project seeked to update profiles for the following areas: Industrial Maintenance (new); Drafting (1990); Electronics (1986); Welding (1986); Machine Shop (1988). Second, the project seeked to crosswalk the updated profiles to nationally established skill and apprenticeship standards. Third, the project seeked to develop performance objectives for each competency on the updated profiles. The completion of this general goal required completion of the following more specific objectives:

1. In cooperation with DESE personnel, select advisory committees for each program area.
2. Send current profiles from each area to the advisory committees for review.
3. Hold a two-day meeting of the advisory committee for each program area. At the meetings review and update the profiles via an appropriate occupational analysis process.
4. For each program area, identify nationally established skill and apprenticeship standards.
5. Submit updated profiles to educators and industry representatives for review.
6. Hold a second one-day meeting of each advisory committee to crosswalk the competency profile to the nationally established skill and apprenticeship standards.

7. In cooperation with DESE personnel, select instructional design committees for each program area.
8. Hold a two-day meeting of the instructional design committee for each program area to develop performance objectives for each competency on the updated profiles.
9. Submit the performance objectives to a minimum of ten sites for technical review/field test.
10. Review all materials to ensure they are free of racial and sexual bias.

POPULATION AND SAMPLE

Our cost-recovery materials are developed for all areas of vocational education for use by secondary schools, vocational-technical schools, junior colleges, and other institutions of higher and special education. Our field testing and advisory committee assistance is drawn from the personnel involved in these educational institutions and industry representatives.

CONCLUSIONS AND RECOMMENDATIONS

After the vocational educational curriculum priorities were determined, curriculum materials were developed under the direction of selected PAVTE faculty members and DESE personnel with the assistance of IML staff. Committees of local teachers, administrators, and business and industry representatives from the state were involved in setting curriculum development priorities and in identifying content for the curriculum resources developed. All of the guides in this report have undergone this developmental process.

DISCLAIMER

The following disclaimer was shown on all curriculum disseminated as a result of this project: "The activity which is the subject of this report was supported in whole or in part of funds from the Department of Elementary and Secondary Education, Division of Vocational and Adult Education. However, the opinions expressed herein do not necessary reflect the position or policies of the Missouri Department of Elementary and Secondary Education or the Division of Vocational and Adult Education, and no official endorsement should be inferred."

Name: _____ **Mathematics in Business** 20–0200–C

Directions: Evaluate the student by checking the appropriate number or letter to indicate the degree of competency. The rating for each task should reflect **employability readiness** rather than the grades given in class.

Rating Scale:
- 3 **Mastered** - can work independently with no supervision
- 2 **Requires Supervision** - can perform job completely with limited supervision
- 1 **Not Mastered** - requires instruction and close supervision
- N **No Exposure** - no experience or knowledge in this area

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Instructional Materials Laboratory
2316 Industrial Drive
Columbia, Missouri 65202
1-314-882-2883

NOTE: Students should have an understanding of basic math competencies, such as adding, subtracting, multiplying, dividing, reading, writing, and pronouncing whole numbers, fractions, decimals, and percents. They should be able to perform common conversions with mixed numbers (e.g., convert fractions to decimals, convert percents to fractions) and to compute averages. Computer skills are also helpful when using this profile.

Duty bands and competencies do not need to be taught in any particular order. Some duty bands and competencies can be integrated and taught together. Team teaching is encouraged. Competencies completed will depend on the length of the course. The code in parentheses is the competency identification number used in computerized management systems.

3	2	1	N

A. Math Applications

1. Compare career opportunities that use mathematical concepts in everyday work (A001)
2. Proofread numerical data (A002)
3. Develop and apply math shortcuts to solve business problems (A003)
4. Compare an estimated answer to a computed solution (A004)
5. Apply problem-solving processes to real-world situations (A005)
6. Communicate mathematical solutions (oral and written) (A006)
7. Utilize team skills to analyze and solve business math problems (A007)

Others (specify):

_____

_____

3	2	1	N

B. Workplace Technology

1. Define math terms related to the workplace (e.g., gross pay, net pay, FICA, commission) (B001)
2. Complete employee payroll forms (e.g., W-4, W-2, insurance) (B002)
3. Operate a calculator by the touch method (B003)
4. Determine and count back change to customers (B004)
5. Express a numerical relationship as a ratio (B005)
6. Calculate markups and markdowns based on cost and selling prices (B006)

3	2	1	N

7. Calculate trade and cash discounts (B007)
8. Complete business forms related to sales and purchasing (e.g., requisition, purchase order, invoice) (B008)
9. Compute inventory values using LIFO, FIFO, average cost (B009)
10. Compare/contrast inventory values (e.g., LIFO, FIFO, average cost) (B010)
11. Compute depreciation expense (e.g., using I.R.S. tables and software) (B011)
12. Compare/contrast depreciation methods (e.g., straight line, weighted average, double declining balance) (B012)
13. Identify the order of mathematical operations as it relates to computer spreadsheet applications (B013)
14. Analyze business data using statistical functions (e.g., @, avg, sum, max, if) (B014)
15. Construct and interpret computer-generated business graphs and/or charts (B015)
16. Assess the cost-effectiveness of telecommunication services (e.g., car phone, FAX, e-mail, bulletin board) (B016)

Others (specify):

_____

_____

3	2	1	N

C. Personal Money Management

1. Compute gross and net earnings for salaried employees (C001)
2. Compute gross and net earnings for hourly employees (C002)
3. Compute gross and net earnings for commissioned employees (C003)
4. Compute gross and net earnings for piecework employees (C004)
5. Calculate the value of non-compensation employee benefits (e.g., vacation, health insurance) (C005)
6. Prepare personal budgets (C006)
7. Record checking account transactions and maintain accurate balances (C007)
8. Compute simple interest (C008)
9. Compute compound interest (C009)
10. Evaluate characteristics, costs, and benefits of investments (e.g., savings account, IRA, CD, annuity) (C010)
11. Analyze amortization schedules for short- and long-term loans (C011)
12. Compare interest and other charges (e.g., annual fees, late fees) on credit cards (C012)
13. Compare insurance rates and services (C013)
14. Compute property taxes (C014)
15. Complete personal federal income tax forms (C015)
16. Complete personal state income tax forms (C016)

Others (specify):

_____

_____

3	2	1	N

D. Entrepreneurial Math

1. Develop a business plan (D001)
2. Investigate types and costs of business loans (D002)
3. Determine the cost of employee benefits and employer taxes (e.g., health insurance, FICA, disability, unemployment) (D003)
4. Complete business tax forms (e.g., income, sales, payroll) (D004)
5. Prepare and interpret financial statements (D005)
6. Compute working capital and return on assets (D006)
7. Apply probability measures to determine chances of business success (D007)
8. Describe consequences of business closure and/or restructuring (e.g., liquidation, downsizing, bankruptcy) (D008)

Others (specify):

_____

_____

3	2	1	N

E. International Math

1. Apply currency exchange rates (E001)
2. Compare/contrast the cost of living and standard of living in the United States with other countries (E002)
3. Measure weight in standard (English) and metric units (E003)
4. Measure distance in standard (English) and metric units (E004)
5. Measure volume in standard (English) and metric units (E005)

Others (specify):

_____

_____

Name: _____ **Business Economics** 20–0055–C

Directions: Evaluate the student by checking the appropriate number or letter to indicate the degree of competency. The rating for each task should reflect **employability readiness** rather than the grades given in class.

Rating Scale:
- **3 Mastered** - can work independently with no supervision
- **2 Requires Supervision** - can perform job completely with limited supervision
- **1 Not Mastered** - requires instruction and close supervision
- **N No Exposure** - no experience or knowledge in this area

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NOTE: Duty bands and competencies do not need to be taught in any particular order. Some duty bands and competencies can be integrated and taught together. Team teaching is encouraged. Competencies completed will depend on the length of the course. The code in parentheses is the competency identification number used in computerized management systems.

Students need to understand that the accelerated pace of change, globalization, and shifting technologies are fixtures, not options, in most industries.

3	2	1	N

A. Production

1. Identify production factors affecting supply and demand (e.g., economies of scale, technology) (A001)
2. Evaluate production factors affecting supply and demand (e.g., economies of scale, technology) (A002)
3. Identify demographic changes in the workforce that affect performance (A003)
4. Evaluate the impact of employment/ unemployment on production (A004)
5. Define factors of production (e.g., labor, capital, entrepreneurship, natural resources) (A005)
6. Explain economic scarcity as it applies to production (A006)
7. Define specialization (A007)
8. Identify how specialization may affect the economy (A008)
9. Explain the benefits of absolute and comparative advantage (e.g., domestic, international) (A009)
10. Explain the principle of diminishing returns and how it relates to productivity (A010)
11. Compare and contrast different types of business ownership (e.g., corporation, partnership, sole proprietorship) (A011)
12. Explain the role of the entrepreneur in a market system (A012)
13. Describe technology-related trends in the production and distribution of goods and services (A013)
14. Describe the impact of technology on individual productivity (A014)
15. Define gross domestic product (GDP) (A015)
16. Interpret fluctuations in gross domestic product (GDP) (A016)
17. Explain the influence of productivity on economic vitality (A017)

Others (specify):

_____

_____

3	2	1	N

B. Consumption

1. Explain economic scarcity as it applies to consumption (B001)
2. Determine trade-offs and opportunity costs (e.g., utility functions) (B002)
3. Identify consumption factors affecting supply and demand (e.g., consumer preferences, elasticity, substitution) (B003)
4. Evaluate consumption factors affecting supply and demand (e.g., consumer preferences, elasticity, substitution) (B004)
5. Explain the principle of diminishing returns and how it relates to consumption (B005)
6. Evaluate the effects of government actions on the economy (B006)
7. Evaluate the impact of employment/ unemployment on consumption (B007)

Others (specify):

_____

_____

3	2	1	N

C. Exchange

1. Explain the law of supply and demand (C001)
2. Identify exchange factors affecting supply and demand (e.g., competition, price) (C002)
3. Evaluate exchange factors affecting supply and demand (e.g., competition, price) (C003)
4. Explain economic scarcity as it applies to exchange (C004)
5. Find and interpret the market clearing/ equilibrium price (C005)
6. Define money (e.g., characteristics, role, forms) (C006)
7. Explain the role of credit in a market economy (C007)
8. Explain the role of banks in facilitating the exchange of financial resources (e.g., loans, creating money, checking accounts, Federal Reserve System) (C008)
9. Explain how currency exchange rates affect international trade (C009)
10. Describe the effect of the global economy on U.S. markets (C010)
11. Identify governmental regulations that influence international trade (e.g., balance of trade, quotas, tariffs, embargoes, employment, free trade) (C011)
12. Describe how imports/exports affect the balance of trade (C012)

(Cont. on back of profile)

3	2	1	N

C. Exchange (Cont.)

13. Identify the impact of the political structure on economic systems (C013)
14. Compare and contrast economic systems (e.g., traditional, market, command, mixed) based on criteria such as freedom, efficiency, equity, security, employment, stability, and growth (C014)
15. Describe how economic activity in one nation affects the rest of the world and vice versa (C015)
16. Describe the role of businesses and individuals in the circular flow (C016)
17. Describe the role of government in the circular flow (e.g., taxation, services, national debt) (C017)
18. Explain how taxation, spending, and financial assistance affect business firms and individuals in an economy (C018)
19. Evaluate the impact of employment/unemployment on exchange (C019)
20. Describe the economic impact of information technologies (C020)

Others (specify):

3	2	1	N

D. Savings

1. Define credit (D001)
2. Evaluate the costs and benefits of credit (D002)
3. Explain the role of banks in the accumulation of financial resources (D003)
4. Predict how inflation/deflation will affect businesses and individuals (D004)
5. Evaluate the impact of employment/unemployment on savings (D005)

Others (specify):

3	2	1	N

E. Investment

1. Define the role of profit-making and not-for-profit companies in the U.S. economy (E001)
2. Describe the budget process (e.g., personal, business, government) (E002)
3. Compare and contrast the national debt and the national deficit (E003)
4. Explain the role of banks in the investment of financial resources (E004)
5. Describe the impact of government regulations on the banking industry (E005)
6. Interpret stock market purpose and function (E006)
7. Analyze stock market performance (E007)
8. Evaluate the impact of employment/unemployment on investment (E008)
9. Explain how international currency exchange rates affect investments (E009)
10. Discuss major barriers to new firms entering a competitive market (E010)

Others (specify):

3	2	1	N

F. Measurement Concepts and Methods

1. Construct tables depicting economic information (e.g., financial statements) (F001)
2. Construct the supply curve (F002)
3. Construct the demand curve (F003)
4. Construct graphs depicting economic information (e.g., pie charts, line graphs, bar graphs) (F004)
5. Determine ratios expressing the relationship of one economic variable to another (F005)
6. Calculate percentages and percentage changes in economic and financial data (F006)
7. Formulate an index number (e.g., consumer price index) (F007)
8. Differentiate between real and nominal values (F008)
9. Interpret economic data depicted through illustrations (e.g., tables, curves, graphs, ratios, percentages, indexes, values) (F009)

Others (specify):

3	2	1	N

G. Careers

1. Identify the types and availability of careers determined by labor market supply and demand (G001)
2. Explain the significance of economics in a chosen career path (G002)
3. Use a decision-making process in the selection of possible careers in the field of economics (G003)
4. Assess the impact of sociological, economic, and technological change on future careers (G004)

Others (specify):

Name: _____

Family/Consumer Resource Management 40-3109-C

Course Rationale:
To assist Missouri citizens in creating stable families, performance competencies in the Family/Consumer Resource Management course taught in Family and Consumer Sciences Education programs enable students to:

a) construct meaning through interpreting family values, needs, wants and goals;
b) communicate effectively with family members and agencies that provide consumer products and services;
c) solve problems that impact family resource management; and,
d) make decisions that contribute to economic stability and quality of life for families.

Directions:
Evaluate the student by checking the appropriate number or letter to indicate the degree of competency. The rating for each task should reflect **employability readiness** rather than the grades given in class.

Rating Scale:
3 Mastered - can work independently with no supervision
2 Requires Supervision - can perform job completely with limited supervision
1 Not Mastered - requires instruction and close supervision
N No Exposure - no experience or knowledge in this area

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3	2	1	N

A. Assuming Leadership Roles as Responsible Family Members and Citizens

1. Utilize FHA/HERO program(s) to address family/consumer resource issues
2. Utilize leadership qualities and skills for problem solving

Other: _____

3	2	1	N

B. Making Informed Choices

1. Describe basic economic principles
2. Identify consumer rights and responsibilities
3. Identify informational resources
4. Evaluate types of advertising
5. Compare methods of record keeping

Other: _____

3	2	1	N

C. Developing Personal Skills

1. Examine personal goals and values based upon wants and needs
2. Relate family goals, values, wants and needs
3. Apply a decision-making process
4. Assess personal resources
5. Report fraudulent practices

Other: _____

3	2	1	N

D. Organizing a Budget

1. Identify available financial resources
2. Examine the importance of savings
3. Devise a budget based on financial needs and wants
4. Evaluate and adjust budget

Other: _____

3	2	1	N

E. Utilizing Financial Services

1. Examine banking services
2. Reconcile a bank statement
3. Explain savings options
4. Compare types of investments
5. Examine financial planning services
6. Determine insurance needs

Other: _____

3	2	1	N

F. Interpreting Taxes

1. Identify types of taxes
2. Describe the costs and benefits of taxation
3. Examine effects of taxes on income
4. Outline types of financial records needed for taxes
5. Determine resources for tax preparation

Other: _____

3	2	1	N

G. Exploring Credit

1. Examine types of credit
2. Examine use of credit cards
3. Investigate processes for establishing/improving a credit rating

Other: _____

3	2	1	N

H. Meeting Housing Needs

1. Identify types of available housing
2. Compare and contrast renting and buying
3. Plan for housing costs
4. Identify legal aspects associated with housing
5. Determine factors affecting housing choice

Other: _____

3	2	1	N

I. Meeting Transportation Needs

1. List advantages and disadvantages of available forms of transportation
2. Determine purchase, operation and maintenance costs of vehicles
3. Explain legal rights and responsibilities of vehicle ownership

Other: _____

3	2	1	N

J. Meeting Clothing Needs

1. Assess clothing value and quality
2. Determine purchases based on values, needs, wants, resources and maintenance

Other: _____

_____

3	2	1	N

K. Meeting Food Needs

1. Compare cost, quality, preparation time and skill required for various food products and services
2. Evaluate food claims

Other: _____

_____

3	2	1	N

L. Meeting Health and Grooming Needs

1. Determine factors for selecting health care services and providers
2. Determine factors for selecting health-care coverage based on needs, cost and availability
3. Evaluate nutrient supplements, alternative health and grooming treatments, and health and grooming devices
4. Maintain a health record-keeping system

Other: _____

_____

3	2	1	N

M. Influencing Change in Environments

1. Develop skills to affect public policy related to family/consumer resource management
2. Analyze the impact of technology on individual and family lifestyles as related to family/consumer resource management
3. Utilize technology and other resources to influence change in family/consumer resource environments

Other: _____

_____

3	2	1	N

N. Researching Key Careers

1. Identify career clusters and careers related to family/consumer resource management
2. Assess personal characteristics and professional requirements for occupations related to family/consumer resource management
3. Investigate working conditions and income of specific careers
4. Use effective communication techniques for multiple workplace situations
5. Examine ethical and professional issues and responsibilities
6. Evaluate entrepreneurial options related to family/consumer resource management

Other: _____

_____

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Name: _____

Family/Individual Health 40-4400-C

Course Rationale:
To improve the health of Missouri citizens, performance competencies in the family/individual health course taught in Family and Consumer Sciences Education programs enable students to:

a) construct meaning pertinent to health care knowledge;
b) communicate effectively with family members and health care providers;
c) solve problems impacting health and wellness; and
d) make responsible health care decisions involving individuals, families, and communities.

Directions:
Evaluate the student by checking the appropriate number or letter to indicate the degree of competency. The rating for each task should reflect **employability readiness** rather than the grades given in class.

Rating Scale:
3 Mastered - can work independently with no supervision
2 Requires Supervision - can perform job completely with limited supervision
1 Not Mastered - requires instruction and close supervision
N No Exposure - no experience or knowledge in this area

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3	2	1	N

A. Assuming Leadership Roles as Responsible Family Members and Citizens

1. Utilize FHA/HERO program(s) to address family/individual health issues
2. Utilize leadership qualities and skills for problem solving

Other: _____

_____

3	2	1	N

B. Promoting Individual Wellness

1. Define wellness
2. Describe lifetime fitness principles and techniques
3. Assess personal health practices and risks
4. Create a personal wellness plan
5. Analyze how the family, peers, community and global issues influence the health of individuals
6. Analyze situations that require professional health service

Other: _____

_____

3	2	1	N

C. Exploring Functions and Interrelationships of Body, Social and Communication Systems

1. Describe functions of body systems including circulatory, digestive, reproductive and skeletal
2. Identify demographic changes that influence family health systems
3. Analyze how family and cultural diversity impact health
4. Defend a position on ethical, legal and environmental issues impacting health systems

Other: _____

_____

3	2	1	N

D. Enhancing Human Growth and Development

1. Describe developmental processes which occur during the life cycle
2. Identify diseases, illnesses and disorders affecting growth and development
3. Describe behaviors for preventing and controlling communicable diseases
4. Develop coping strategies to deal with health deviations and changes in the life cycle

Other: _____

_____

3	2	1	N

E. Promoting Health and Prevention Concepts

1. Describe the changing relationships of mental, emotional, social and physical health throughout life
2. Explain the effects of substance use and abuse on the individual, family and community
3. Evaluate how lifestyle choices impact health
4. Distinguish between appropriate and inappropriate behavior in relationships as they affect health
5. Identify standards of personal hygiene and health

Other: _____

_____

3	2	1	N

F. Promoting Nutritional Health

1. Explain relationships between dietary guidelines and wellness
2. Compare nutritional needs at different stages of the life cycle
3. Identify nutritional needs of individuals with special health deviations

Other: _____

_____

3	2	1	N

G. Maintaining a Safe Environment

1. Describe health emergency procedures
2. Develop accident/injury prevention strategies for personal, home, family and community health
3. Demonstrate refusal and negotiation skills to avoid potentially harmful or exploitive situations
4. Demonstrate strategies for solving interpersonal conflicts without harming self or others
5. Demonstrate methods of avoiding threatening situations

Other: _____

_____

3	2	1	N

H. Accessing Health-Related Information, Products and Services

1. Discriminate between reliable and unreliable health information, products and services
2. Analyze data from multiple sources to make informed decisions about health information, products and services
3. Describe factors that influence personal selection of health-care resources, products and services
4. Demonstrate the ability to access individuals and agencies that provide support and protection
5. Compare costs and benefits of available health-care coverages

Other: _____

_____

3	2	1	N

I. Influencing Change in Environments

1. Develop skills to affect public policy related to family/individual health
2. Analyze the impact of technology on individual and family lifestyles as related to family/individual health
3. Utilize technology and other resources to influence change in family/individual health environments

Other: _____

_____

3	2	1	N

J. Researching Key Careers

1. Identify career clusters and careers related to family/individual health
2. Assess personal characteristics and professional requirements for occupations related to family/individual health
3. Investigate working conditions and income of specific careers
4. Use effective communication techniques for multiple workplace situations
5. Examine ethical and professional issues and responsibilities
6. Evaluate entrepreneurial options related to family/individual health

Other: _____

_____

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Name: _____

Course Rationale:
To improve the health and quality of life of Missouri citizens, performance competencies in the Nutrition and Wellness course taught in Family and Consumer Sciences Education programs enable students to:

a) construct meaning related to nutrition, food economics and ecology;
b) communicate effectively with family members, consumer groups and providers of food and nutrition products and services;
c) solve problems related to health and wellness, as well as food needs through the application of mathematics and science principles; and,
d) make responsible decisions involving family and individual food needs, the use of the food dollar and the care of food.

Directions:
Evaluate the student by checking the appropriate number or letter to indicate the degree of competency. The rating for each task should reflect **employability readiness** rather than the grades given in class.

Rating Scale:
3 Mastered - can work independently with no supervision
2 Requires Supervision - can perform job completely with limited supervision
1 Not Mastered - requires instruction and close supervision
N No Exposure - no experience or knowledge in this area

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3	2	1	N

A. Assuming Leadership Roles as Responsible Family Members and Citizens

1. Utilize FHA/HERO program(s) to address nutrition and wellness issues
2. Utilize leadership qualities and skills for problem solving

Other: _____

_____

3	2	1	N

B. Appraising Influences on Personal Food Choices

1. Identify social and psychological influences affecting food choices
2. Identify cultural and family influences
3. Explain economic and environmental factors influencing food choices
4. Investigate the impact of other influences such as media, fads and myths on food choices
5. Evaluate technological influences on product availability

Other: _____

_____

3	2	1	N

C. Comprehending Nutrition Principles

1. Describe nutrient functions
2. Identify nutrient sources
3. Explain the processes of digestion and food utilization
4. Categorize foods according to nutrient composition
5. Summarize differences in nutrient needs throughout the life cycle

Other: _____

_____

3	2	1	N

D. Recognizing Relationships Between Nutrition and Wellness

1. Identify components of wellness
2. Analyze dietary intake
3. Assess food intake based upon recognized dietary standards
4. Identify dietary practices to promote health
5. Examine special nutritional needs including modified diets, vegetarianism and sports nutrition
6. Identify characteristics of eating disorders
7. Plan daily nutritional intake using recognized standards

Other: _____

_____

3	2	1	N

E. Managing Resources to Promote Good Health

1. Identify resources used in planning meals and food preparation
2. Evaluate features, price, quality and intended use of food preparation equipment
3. Develop criteria for purchasing/obtaining food
4. Identify programs providing food assistance and nutrition services
5. Identify regulatory agencies and their services
6. Discriminate between sources of reliable and unreliable food/nutrition information, products and services

Other: _____

_____

3	2	1	N

F. Developing Food Preparation Skills

1. Plan nutritious and aesthetically pleasing menus
2. Demonstrate safe and sanitary food preparation practices
3. Apply basic science, mathematics and time management principles in food preparation
4. Evaluate products based upon quality standards

Other: _____ _____

_____

3	2	1	N

G. Developing Social Competence

1. Identify importance of etiquette
2. Demonstrate appropriate etiquette for various types of dining situations
3. Develop strategies for positive mealtime interaction

Other: _____

_____

3	2	1	N

H. Influencing Change in Environments

1. Develop skills to affect public policy related to nutrition and wellness
2. Analyze the impact of technology on individual and family lifestyles as related to nutrition and wellness
3. Utilize technology and other resources to influence change in nutrition and wellness environments

Other: _____

_____

3	2	1	N

I. Researching Key Careers

1. Identify career clusters and careers related to nutrition and wellness
2. Assess personal characteristics and professional requirements for occupations related to nutrition and wellness
3. Investigate working conditions and income of specific careers
4. Use effective communication techniques for multiple workplace situations
5. Examine ethical and professional issues and responsibilities
6. Evaluate entrepreneurial options related to nutrition and wellness

Other: _____

_____

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Name: _____

Housing, Home Furnishings and Equipment 40-6100-C

Course Rationale:
To improve the quality of life for Missouri citizens, performance competencies in the Housing, Home Furnishings and Equipment course taught in Family and Consumer Sciences Education programs enable students to:

a) construct meaning related to living environments;
b) communicate effectively with family members and providers of environmentally related products and services;
c) solve problems related to the physical, psychological and sociological influences that impact families in various living environments; and
d) make the complex, responsible decisions necessary to create desirable living environments.

Directions:
Evaluate the student by checking the appropriate number or letter to indicate the degree of competency. The rating for each task should reflect **employability readiness** rather than the grades given in class.

Rating Scale:
3 Mastered - can work independently with no supervision
2 Requires Supervision - can perform job completely with limited supervision
1 Not Mastered - requires instruction and close supervision
N No Exposure - no experience or knowledge in this area

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3	2	1	N

A. Assuming Leadership Roles as Responsible Family Members and Citizens

1. Utilize FHA/HERO program(s) to address housing, home furnishings and equipment issues
2. Utilize leadership qualities and skills for problem solving

Other: _____

3	2	1	N

B. Choosing a Living Environment

1. Analyze needs, values and goals
2. Relate family lifestyles to housing expectations
3. Relate the life cycle to housing needs
4. Describe the components of the macro-environment to include quality of life, demographics, community, neighborhood, air and transportation
5. Recognize types of housing
6. Relate the needs of special populations to housing
7. Identify social and environmental factors affecting housing costs and choices
8. Examine historical and social influences on architectural styles

Other: _____

3	2	1	N

C. Securing a Living Environment

1. Investigate procedures and financial responsibilities for obtaining housing
2. Investigate legal responsibilities
3. Compare renting to buying
4. Identify factors related to moving

Other: _____

3	2	1	N

D. Creating a Living Environment

1. Apply elements and principles of design
2. Evaluate floor plans for individual and family needs
3. Explore materials and finishes
4. Identify factors influencing selection of appliances
5. Explore types and uses of lighting
6. Identify furniture styles
7. Investigate selection of furniture and accessories
8. Relate furnishings to budget

Other: _____

3	2	1	N

E. Maintaining the Living Environment

1. Identify factors related to home safety and security
2. Determine maintenance, care and repair factors

Other: _____

3	2	1	N

F. Influencing Change in Environments

1. Develop skills to affect public policy related to housing, home furnishings and equipment
2. Analyze the impact of technology on individual and family lifestyles as related to housing, home furnishings and equipment
3. Utilize technology and other resources to influence change in living environments

Other: _____

3	2	1	N

G. Researching Key Careers

1. Identify career clusters and careers related to housing, home furnishings and equipment
2. Assess personal characteristics and professional requirements for occupations related to housing, home furnishings and equipment
3. Investigate working conditions and income of specific careers
4. Use effective communication techniques for multiple workplace situations
5. Examine ethical and professional issues and responsibilities
6. Evaluate entrepreneurial options related to housing, home furnishings and equipment

Other: _____

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Name: _____

Family Living and Parenthood 40-7150-C

Course Rationale:
To assist Missouri citizens in creating stable families, performance competencies in the Family Living and Parenthood course taught in Family and Consumer Sciences Education programs enable students to:

a) construct meaning by interpreting the nature, function and significance of human relationships;
b) communicate effectively with family members and agencies that provide family related products and services;
c) solve problems based upon the developmental needs of individuals; and,
d) make decisions that strengthen and maintain family relationships, prepare individuals for marriage and parenthood and reduce disruptive conditions that destabilize families.

Directions:
Evaluate the student by checking the appropriate number or letter to indicate the degree of competency. The rating for each task should reflect **employability readiness** rather than the grades given in class.

Rating Scale:
3 Mastered - can work independently with no supervision
2 Requires Supervision - can perform job completely with limited supervision
1 Not Mastered - requires instruction and close supervision
N No Exposure - no experience or knowledge in this area

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3	2	1	N	A. **Assuming Leadership Roles as Responsible Family Members and Citizens**
				1. Utilize FHA/HERO program(s) to address family living and parenthood issues
				2. Utilize leadership qualities and skills for problem solving
				Other: _____
				_____

3	2	1	N	B. **Developing a Positive Self-Concept**
				1. Evaluate personal needs, wants, values and short- and long-term goals
				2. Examine factors influencing personality development
				3. Analyze the effects of values on personal thoughts, attitudes, actions and life roles
				4. Determine methods for setting priorities
				5. Identify strategies for promoting responsible behaviors
				6. Evaluate personal problem-solving and decision-making skills
				Other: _____
				_____

3	2	1	N	C. **Demonstrating Effective Communication Skills Among Family, Peers and Others**
				1. Create communications using a variety of methods, forms and technologies
				2. Evaluate interpersonal communication techniques
				3. Identify and evaluate the effects of cultural influences on communication
				Other: _____
				_____

3	2	1	N	D. **Explaining the Progression of Relationships and Families**
				1. Evaluate personal and environmental factors influencing relationship choice, development and termination
				2. Develop responsible behaviors related to sexuality
				3. Analyze trends in family structure
				Other: _____
				_____

3	2	1	N	E. **Exploring Family Life Issues within a Diverse Society**
				1. Analyze interrelationships of personal and family goals and values to work goals and values
				2. Analyze how social, economic and technological changes impact work and family dynamics
				3. Devise strategies for coordinating work and family responsibilities
				4. Generate guidelines for reducing and resolving family conflict
				5. Demonstrate skills needed to be a contributing family and community member
				6. Explain the implications of cultural diversity when dealing with family and community issues
				7. Analyze factors leading to stress and resiliency in families
				8. Develop strategies to manage common sources of stress for individuals and families
				9. Assess community resources available to individuals and families
				10. Evaluate family problem-solving and decision-making skills
				Other: _____
				_____

3	2	1	N

F. Making Responsible Parenting Decisions

1. Identify characteristics of positive parenting
2. Identify parental rights and responsibilities to have and keep children
3. Evaluate impact of children on resources
4. Compare and contrast parenting issues related to various family types

Other: _____

_____

3	2	1	N

G. Influencing Change in Environments

1. Develop skills to affect public policy related to family living and parenthood
2. Analyze the impact of technology on individual and family lifestyles as related to family living and parenthood
3. Utilize technology and other resources to influence change in family and parenting environments

Other: _____

_____

3	2	1	N

H. Researching Key Careers

1. Identify career clusters and careers related to family studies
2. Assess personal characteristics and professional requirements for family study occupations
3. Investigate working conditions and income of specific careers
4. Use effective communication techniques for multiple workplace situations
5. Examine ethical and professional issues and responsibilities
6. Evaluate entrepreneurial options related to family studies

Other: _____

_____

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Name: _____

Child Development, Care and Guidance 40-7705-C

Course Rationale:
To improve the quality of life for Missouri's children, performance competencies in the Child Development, Care and Guidance course taught in Family and Consumer Sciences Education programs enable students to:

a) construct meaning pertinent to child care, guidance and supervision;
b) communicate effectively with family members, child care agencies and professional service providers;
c) solve problems based upon the developmental needs of children;
d) make decisions that support the sound physical, mental and social development of children; and
e) assess the impact of the parenting role in society.

Directions:
Evaluate the student by checking the appropriate number or letter to indicate the degree of competency. The rating for each task should reflect **employability readiness** rather than the grades given in class.

Rating Scale:
3 Mastered - can work independently with no supervision
2 Requires Supervision - can perform job completely with limited supervision
1 Not Mastered - requires instruction and close supervision
N No Exposure - no experience or knowledge in this area (IBM) 10-95

3	2	1	N

A. Assuming Leadership Roles as Responsible Family Members and Citizens

1. Utilize FHA/HERO program(s) to address child development, care and guidance issues
2. Utilize leadership qualities and skills for problem solving

Other: _____

3	2	1	N

B. Describing Diverse Roles in Parenting

1. Evaluate factors and choices related to parenting
2. List changes and adaptations needed for parenting roles
3. Describe parenting practices in different cultures

Other: _____

3	2	1	N

C. Analyzing Health Concerns and Needs During Prenatal Development

1. Describe fetal development during pregnancy
2. Describe the process of labor and delivery
3. Explain effects of substance use and abuse related to pregnancy
4. Identify genetic factors that affect pregnancy
5. Assess environmental factors that affect pregnancy

Other: _____

3	2	1	N

D. Explaining Developmental Stages (Physical, Social, Emotional and Cognitive)

1. Distinguish among developmental stages
2. Explain individual differences in development
3. Relate individual differences to predictable developmental sequences
4. Propose ways to optimize development through play

Other: _____

3	2	1	N

E. Justifying Interaction Choices

1. Identify guidance/discipline techniques
2. Exhibit communication skills that promote positive self-esteem

Other: _____

3	2	1	N

F. Distinguishing Health Concerns at Developmental Stages

1. Describe community health services
2. Determine appropriate first-aid procedures
3. Devise a comprehensive plan for childhood wellness

Other: _____

3	2	1	N

G. Identifying Guidelines for Creating Safe Environments

1. List components of a safe environment
2. Describe signs of abuse and neglect
3. Describe available community resources for violence prevention, reporting and counseling

Other: _____

3	2	1	N

H. Comparing Child Care Options

1. Summarize criteria for quality child care
2. Evaluate costs and features of available child care options

Other: _____

3	2	1	N

I. Influencing Change in Environments

1. Develop skills to affect public policy related to child development, care and guidance
2. Analyze the impact of technology on individual and family lifestyles as related to child development, care and guidance
3. Utilize technology and other resources to influence change in child development, care and guidance environments

Other: _____

3	2	1	N	J. **Researching Key Careers**
				1. Identify career clusters and careers related to child development, care and guidance
				2. Assess personal characteristics and professional requirements for occupations related to child development, care and guidance
				3. Investigate working conditions and income of specific careers
				4. Use effective communication techniques for multiple workplace situations
				5. Examine ethical and professional issues and responsibilities
				6. Evaluate entrepreneurial options related to child development, care and guidance
				Other: _____
				_____

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Employability Competencies

Personal Characteristics

Directions: Rate the student by checking the appropriate number on each scale. The ratings should be based on your **observation of the student** rather than grades given in class.

Rating Scale: 3 Above Average
2 Average
1 Below Average

3	2	1	
			Personal Characteristics
			1. **Relations with others** (effectiveness in working with students, instructors, and others; cooperation; shows respect)
			2. **Dependability** (attendance, punctuality; adherence to schedules and deadlines; consistency and results; perseverance)
			3. **Work attitudes** (willingness to learn; willingness to accept and profit from evaluation; enthusiasm; initiative; commitment; pride in work)
			4. **Communication** (listening, speaking, and nonverbal skills; effectiveness in communicating with students, teachers, and others)
			5. **Personal hygiene/grooming** (personal health care and cleanliness; dresses and maintains self appropriately)
			Others (specify):

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Job Seeking Techniques

Directions: Evaluate the student by checking the appropriate number or letter to indicate the degree of competency. The rating for each task should reflect **employability readiness** rather than the grades given in class.

Rating Scale: 3 Above Average
2 Average
1 Below Average
N No Exposure

3	2	1	N	
				Job Seeking Techniques
				1. Apply information about self and job opportunities in career decision making
				2. Write a resume
				3. Prepare a job application form
				4. Write letters of application and acceptance
				5. Arrange for personal references
				6. Apply job search techniques
				7. Arrange a job interview
				8. Apply job interview techniques
				9. Evaluate job offers (actual or simulated)
				Others (specify):

Entrepreneurship Awareness

Directions: Evaluate the student by checking the appropriate number or letter to indicate the degree of competency. The rating for each task should reflect **employability readiness** rather than the grades given in class.

Rating Scale: 3 Above Average
2 Average
1 Below Average
N No Exposure

3	2	1	N	
				Entrepreneurship Awareness
				1. Describe five characteristics of a free enterprise economic system (ownership of property, profit motive, risk taking, competition, supply and demand)
				2. Name four forms of business ownership (sole proprietorship, partnership, corporation, cooperative)
				3. Describe advantages and disadvantages of small business ownership
				4. Identify steps necessary to start a business (evaluate need, site selection, marketing plan, financial plan, management plan)
				5. Identify business opportunities related to training
				6. Identify personal traits of the entrepreneur (versatility, aspirations, energy, integrity, adaptability, etc.)
				Others (specify):

40

Competency Profile

Instructor: _____

Instructional Program: _____

_____

School: _____

School Address: _____

_____

Student: _____

Address: _____

_____

Telephone: _____

Social Security Number: _____

IN CASE OF EMERGENCY, CONTACT

Name: _____

Telephone: _____

Family Doctor: _____

Telephone: _____

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Date of Enrollment: _____

Date of Withdrawal: _____

Date of Completion: _____

Total Hours Absent: _____

Total Instructional Hours: _____

Total On-The-Job Training Hours: _____

On-The-Job Training/Work Experience

Duration of Employment	Job Title	Job Description	Supervisor's Name	Name/Address of Employer	Telephone

The following profile ratings represent the knowledges, skills, and attitudes that this student has demonstated at a given time under given conditions. It does not necessarily represent certification of future abilities.

This project was supported in whole or in part by funds from the Department of Elementary and Secondary Education, Division of Vocational and Adult Education. However, the opinions expressed herein do not necessarily reflect the position or policies of the Missouri Department of Elementary and Secondary Education, Division of Vocational and Adult Education, and no official endorsement should be inferred.

Directions: Evaluate the student by checking the appropriate number or letter to indicate the degree of competency. The rating for each task should reflect **employability readiness** rather than the grades given in class.

Rating Scale:
3 Mastered - can work independently with no supervision
2 Requires Supervision - can perform job completely with limited supervision
1 Not Mastered - requires instruction and close supervision
N No Exposure - no experience or knowledge in this area

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NOTES:

* = Core competencies (essential for the first day on the job)

Numbers in brackets (e.g., A01) represent the IDs used in computerized tracking software.

3	2	1	N	1. Drafting Room Procedures	CADD (FIM)
				*1. Apply safety policies and procedures [A01]	2.2.2
				*2. Identify drafting terminology [A06]	
				*3. Identify American National Standards Institute, Inc. (ANSI) and International Standards Organization (ISO) standards (terminology) [A03]	1.1.7
				*4. Identify drafting occupations and related fields [A04]	
				5. Apply record-keeping procedures (filing and record retrieval) [A05]	
				6. Identify and apply ergonomic considerations [A07]	
				Other:	

3	2	1	N	2. Tools and Equipment	2.2.1
				*1. Select proper drawing instruments and equipment to complement the drafting media (e.g., Mylar, vellum) [B01]	1.1.1
				*2. Demonstrate proper use, care and adjustment of drawing instruments and equipment and computer equipment [B02]	2.1.1, 2.1.5, 2.1.6
				*3. Produce copies (e.g., stick-on decals, sepia and blueline copies) [B03]	1.1.8
				*4. Operate and adjust input devices (e.g., mouse, keyboard, digitizer, scanner) [B07]	2.1.2
				*5. Operate and adjust output devices (e.g., printers, plotters, data transfer) [B08]	2.1.3, 2.1.7
				*6. Identify and use data storage, retrieval and back-up systems [B09]	2.1.4, 2.3.2, 2.3.3, 2.3.5, 2.3.8
				7. Identify operating systems and procedures [B10]	2.3.1, 2.3.4, 2.3.7
				Other:	

3	2	1	N	3. Basic Drawing Skills	
				*1. Lay out drawing [C01]	
				*2. Construct borders and information blocks [C02]	1.1.5
				*3. Construct freehand sketches [C03]	1.1.9
				*4. Read and transfer measurements (English and metric) [C04]	1.1.2, 1.1.6
				*5. Letter freehand (letters and numerals) [C05]	
				*6. Demonstrate techniques in line construction (e.g., weights, types and uniformity) [C06]	1.1.4
				*7. Construct a reproducible drawing with mechanical pencils [C08]	
				8. Construct a reproducible drawing with technical ink pens [C09]	
				*9. Perform basic geometric construction (e.g., line dividing, angles, tangents, polygons, arcs) [C11]	
				10. Identify and use various annotation methods [C12]	1.1.3
				Other:	

3	2	1	N	13. Introduction to Production Manufacturing Drawing	CADD (FIM)
				1. Identify use and application of threads and fasteners (e.g., bolts, pins, keys) [O04]	
				2. Identify manufacturing processes (e.g., machine processes, metal forming, CNC) [O05]	
				3. Produce detail drawings applying standard machine fits, finishes and tolerances [O06]	
				4. Produce machine assembly drawing [O07]	
				5. Apply standard fits, finishes and tolerances to machine drawing [O08]	
				6. Develop a parts list [O02]	
				7. Produce drawings for welded component parts [O09]	
				8. Produce drawings for metal bending and fabricating [O10]	
				9. Produce drawings for non-steel materials [O11]	
				10. Produce drawings for CAD/CAM applications [O12]	
				11. Produce drawing for cams [O13]	
				12. Produce drawing for gears [O14]	
				Other:	

3	2	1	N	14. Introduction to Architectural Drawings	
				1. Construct architectural symbols [K01]	1.1.7
				2. Identify architectural design and planning principles [K05]	
				3. Identify basic construction terminology and materials [K06]	
				4. Produce site plan [K07]	
				5. Identify applicable building codes [K08]	
				6. Prepare a schedule using a freehand architectural style lettering [K09]	1.1.3
				7. Measure, sketch and draft an as-built floor plan [K10]	1.1.2, 1.1.9
				8. Produce typical wall and building sections with necessary details [K11]	
				9. Produce floor plans [K02]	
				10. Produce elevation drawings [K12]	
				Other:	

3	2	1	N	15. Introduction to Residential and Commercial Wiring Drawings	
				1. Identify electrical symbols [W01]	1.1.7
				2. Identify applicable codes (e.g., IEC, NEC and IEEE) [W02]	
				3. Produce wiring schematics [W03]	
				Other:	

3	2	1	N	16. Introduction to Electronic Drawings	
				1. Identify electronic symbols [X01]	1.1.7
				2. Produce electronic/electrical schematics and diagrams [X02]	
				Other:	

				*1. Identify use and application of orthographic drawings (3rd angle) [E04]	
				*2. Identify 1st and 3rd angle projection drawings [E05]	
				*3. Interpret an orthographic projection (3rd angle) [E01]	
				*4. Sketch multiview drawings (3rd angle) [E02]	1.1.9
				*5. Prepare orthographic drawings (3rd angle) [E03]	
				Other:	

3	2	1	N	5. Auxiliary Views	1.2.2
				*1. Identify use and application of auxiliary views [F04]	
				*2. Construct primary auxiliary views [F01]	
				3. Construct secondary auxiliary views [F03]	
				Other:	

3	2	1	N	6. Descriptive Geometry/Revolutions	
				1. Perform graphic solutions of points, lines and planes [I06]	
				2. Solve true length of lines, bearing and slope of lines [I07]	
				3. Perform graphic solutions of solids [I04]	
				4. Perform graphic solutions of intersections (e.g., lines, planes and solids) [I05]	
				5. Construct drawings using the revolution method [I08]	
				Other:	

3	2	1	N	7. Sectional Views/Conventions	1.2.3
				*1. Identify and draw standard sectional views [G01]	
				*2. Identify the symbols used to represent different materials [G02]	
				*3. Identify and use cutting planes [G03]	
				*4. Identify and use conventional breaks [G04]	
				*5. Identify use and application of sectional views [G05]	
				Other:	

3	2	1	N	8. Pictorial Drawings	
				*1. Identify use and application of pictorial drawings [J03]	1.3.1-1.3.3
				*2. Sketch pictorial drawings [J04]	1.1.9
				*3. Construct axonometric, oblique and perspective drawings [J05]	1.3.2
				Other:	

3	2	1	N	9. Dimensioning and Tolerancing as Applied to Specific Drafting Fields	1.1.3, 1.1.6, 1.4.1
				*1. Construct the lines used to dimension drawings [H02]	1.4.2
				*2. Identify and apply dimensioning practices [H01]	1.4.3-1.4.6, 1.4.8, 1.4.9
				*3. Identify and apply tolerancing [H08]	1.4.10
				4. Identify and apply geometric dimensioning and tolerancing techniques [H07]	1.4.10
				*5. Dimension drawing using ANSI and ISO standards [H09]	1.4.7, 1.1.6
				Other:	

3	2	1	N	10. Applied Mathematical Skills	
				*1. Apply basic mathematic principles [S01]	1.1.2, M1, M2, M13
				*2. Apply basic geometric principles [S02]	M5-M8
				*3. Apply basic trigonometric principles [S03]	M12

				1. Identify piping symbols, fittings, fixtures and valves [M01]	1.1.7
				2. Identify applicable codes [M03]	
				3. Identify principles of pneumatics and hydraulics [M04]	
				4. Produce orthographic drawings [M05]	
				5. Produce isometric drawings [M06]	
				Other:	

3	2	1	N	18. Introduction to Structural Steel Drawings	
				1. Identify structural steel shapes [N01]	
				2. Identify applicable codes (OSHA, AWS, SJI and BOCA) [N04]	
				3. Identify and apply welding symbols [N05]	1.1.7
				4. Identify open-web joist types and applications [N06]	
				5. Produce a steel framing plan drawing [N02]	
				6. Produce a detail and assembly drawing (including beam connections) with bill of materials [N03]	
				7. Sketch complex connections [N07]	1.1.9
				Other:	

3	2	1	N	19. Introduction to Civil/GIS (Geographic Information System) Drawings	
				1. Identify symbols [Y01]	1.1.7
				2. Identify uses of GIS and GPS (global positioning systems) [Y02]	
				3. Produce a contour plan [Y03]	
				4. Produce a profile drawing [Y04]	
				5. Produce a land survey plot from written description [Y05]	
				Other:	

3	2	1	N	20. Introduction to Sheet Metal/HVAC Drawings	
				1. Identify applicable codes (e.g., ASHRAE) [Q04]	
				2. Produce representative sheet metal drawings [Q02]	
				3. Identify sheet metal layout procedures [Q03]	
				4. Identify HVAC symbols [Q05]	1.1.7
				5. Produce sheet metal drawings for CAD/CAM applications [Q06]	
				6. Prepare HVAC ductwork plan [Q07]	
				Other:	

3	2	1	N	21. Leadership Competencies**	
				1. Demonstrate an understanding of VICA, its structure and activities [T01]	
				2. Demonstrate an understanding of one's personal values [T02]	
				3. Perform tasks related to effective personal management skills [T03]	
				4. Demonstrate interpersonal skills [T04]	
				5. Demonstrate etiquette and courtesy [T05]	
				6. Demonstrate effectiveness in oral and written communication [T06]	
				7. Develop and maintain a code of professional ethics [T07]	
				8. Maintain a good professional appearance [T08]	
				9. Perform basic tasks related to securing and terminating employment [T09]	
				10. Perform basic parliamentary procedures in a group	

				*1. Create new 2-D drawings [U01]	[illegible]
				*2. Perform drawing setup to applicable standards (e.g., settings, layers, line types and widths) [U02]	3.1.2, 3.3.1
				*3. Identify and use view and display commands (e.g., zoom, pan, viewpoints, rotation, shading) [U03]	3.1.5, 3.3.3, 3.3.4, 4.3.1-4.3.3
				*4. Use query commands to extract drawing data (e.g., entity characteristics, distance, area, status) [U04]	3.4
				*5. Edit, copy and manipulate drawing entities (e.g., properties, stretch, trimming, scaling) [U05]	3.2.1, 3.2.2, 3.3.2
				*6. Save, retrieve and manage drawings [U06]	3.3.9
				*7. Dimension drawings [U07]	3.5
				*8. Set and change dimensioning variables [U08]	3.5
				*9. Enter and edit text [U09]	3.1.4
				*10. Plot drawings to proper scale [U10]	3.3.6
				11. Identify backup and archival methods [U11]	
				12. Create, edit and retrieve component/symbol libraries (e.g., groups, blocks, symbols, third-party libraries) [U12]	3.1.6, 3.3.5, 3.3.8, 4.5.3
				13. Identify and apply layering techniques [U13]	3.3.7
				14. Identify methods of sharing drawings (e.g., team projects) [U14]	
				Other:	

3	2	1	N	12. Advanced CAD Skills [V]	
				1. Create 3-D drawings using extrusions and wireframes [V01]	3.1.7, 3.1.10, 3.1.11, 4.1.1
				2. Create surface and solid models [V02]	3.1.7, 3.1.11, 4.1.1-4.1.5
				3. Create joined and offset surfaces [V03]	3.1.8, 3.1.10, 4.1.7
				4. Edit solids, curves and surfaces [V04]	4.1.6, 4.1.7-4.1.9, 4.2.1-4.2.6
				5. Create 2-D geometry from 3-D models [V05]	3.1.9
				6. Import and export various file formats (e.g., DXF, IGES, raster) [V06]	2.3.6,4.5.2
				7. Extract geometric and attribute data (e.g., database and component information) [V07]	4.3.2, 4.4.1-4.4.3
				8. Perform customization to improve productivity [V08]	4.5.1
				9. Install and configure software [V09]	
				10. Install and configure hardware [V10]	
				11. Extract surface and mass properties (e.g., area, perimeter, moments of inertia, centroids) [V11]	4.4.4, 4.4.5
				12. Develop geometry using parametric programs [V12]	4.5.4
				Other:	

3	2	1	N	Areas of Specialization
				1.
				2.
				3.
				4.
				5.
				6.
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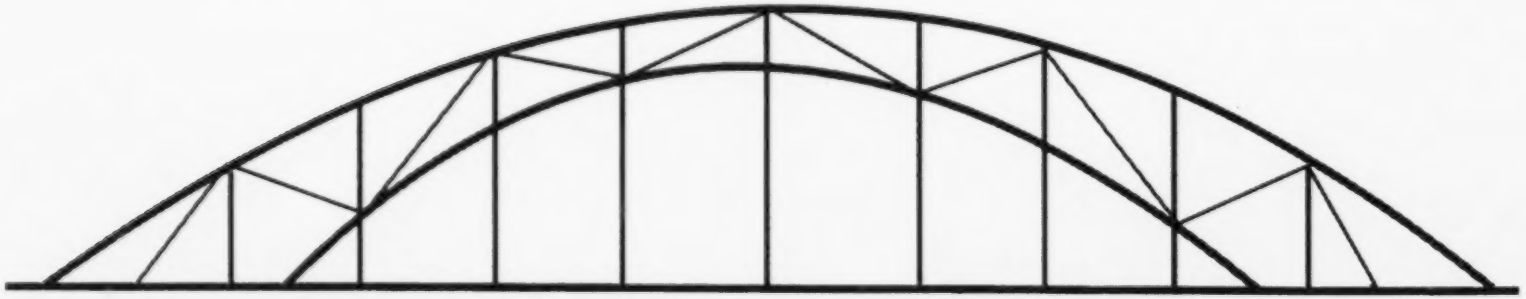
Performance Indicators for Drafting:

A Bridge to Selected Instructional Materials



• National Skill Standards • Missouri Competencies • Show-Me Standards
• All Aspects of the Industry Objectives • Pre-Employment/Work Maturity Skills
• VICA/SCANS Competencies

Instructional Materials Laboratory
University of Missouri-Columbia

February 1996

INTRODUCTION

This curriculum project includes two parts: an updated Drafting competency profile and this performance indicator document. The updated profile contains more information than before. It is cross-referenced to national skill standards (see page 12); core/essential skills are indicated by an asterisk (*); and task IDs for VAMS (Missouri's Vocational Administrative Management System) are shown in brackets.

The Performance Indicator Chart connects technical drafting skills with other important, but more general, skills needed by students. This document also provides instructors and administrators with links between newly updated drafting competencies and (1) previous Mo. competencies, (2) Show-Me Standards for students in Missouri public schools, (3) All Aspects of the Industry objectives, (4) Pre-Employment/Work Maturity Skills, and (5) SCANS competencies (addressed in National VICA's *Total Quality Curriculum).* These sets of skills are listed after the Performance Indicator Chart.

To use the Drafting Performance Indicator Chart, consider the following example. Duty bands (umbrella-like categories for competencies) are in **bold** type and shaded.

	Page 15 ↘	Page 16 ↘	Page 19 ↘	Page 20 ↘
Missouri Competency	**Previous Mo. Competencies**	**Show-Me Standards**	**AAOI Objectives**	**Pre-Employment/ Work Maturity Skills**	**VICA/SCANS Competencies**
1. Drafting Room Procedures					
1.5 Apply record-keeping procedures (filing and record retrieval) [A05]	A5	Goal 1	E1		3

The second column (Previous Mo. Competencies) is helpful for anyone with curriculum tied to the previous Missouri competency list. As indicated by the chart, competency #5 in Drafting Room Procedures is related to previous competency A5. Drafting Room Procedures #5 is also related to the first Show-Me Standard, AAOI Objective E1, and VICA/SCANS Competency 3.

For more detail, obtain or contact the following resources.

- *National Occupational Skill Standards for Computer Aided Drafting and Design (CADD).* Washington, DC: Foundation for Industrial Modernization, 1994.* Contact:
  Foundation for Industrial Modernization, 1331 Pennsylvania Ave. NW, Suite 1410 North, Washington, DC 20004, 202/662-8912 (CADD Project office), 202/662-8960 (main FIM office).
- Drafting competency profile (70-4000-C), test-item bank (70-4000-E) and curriculum guide (70-4000-I). Contact:
  Instructional Materials Laboratory, 2316 Industrial Drive, Columbia, MO 65211, 800/669-2465, FAX 573/882=1992.
- Pre-Employment/Work-Maturity Skills Instructional Resource Guide (30-6000-I). University of Missouri-Columbia: Instructional Materials Laboratory, 1992. Contact:
  IML (see above)

- *All Aspects of the Industry (65-9000-I).* University of Missouri-Columbia: Instructional Materials Laboratory, 1994. Contact: IML (see above)
- *Learning a Living: A Blueprint for High Performance (A SCANS Report for America 2000).* Washington, DC, U.S. Department of Labor, 1992.*
- *Total Quality Curriculum.* Leesburg, VA: National VICA, 1993.* Contact: Education Dept., National VICA, PO Box 3000, Leesburg, VA 22075, 800/321-VICA (8422).
- VIMS/VAMS Support Center, 324 Townsend Hall, UMC, Columbia, MO 65211, 573/882-2951, FAX 573/884=5455.

*These resources are available to Missouri educators for free loan from the Missouri Vocational Resource Center (MVRC), University of Missouri-Columbia, 8 London Hall, Columbia, MO 65211 (800/392-7217, FAX 573/882=9935).

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Many people helped bring this project to completion. In addition to the advisory committee members shown in the box to the right, appreciation is due to the many workers and instructors who validated the competencies. Guidance was provided by Fred Linhardt and Delbert Lund of the Vocational Planning and Evaluation Section, Department of Elementary and Secondary Education. Support and guidance was provided by Mark Ehlert and the VIMS/VAMS Support Center in Columbia. Thanks is due to Instructional Materials Laboratory staff members, especially Harley Schlichting, director; Phyllis Miller, associate director; Dan Stapleton, assistant director; Diane Davis, editor; Jan Trimble, word processor; Traci Wagner, senior clerk typist; and Julie Martin and Becky Tieman, student assistants.

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DRAFTING PERFORMANCE INDICATOR CHART

NOTE: * = core competency (essential for the first day on the job)
Numbers in brackets (e.g., A01) reflect the IDs used in computerized tracking software.

Missouri Competency	Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	Pre-Employment/ Work Maturity Skills	VICA/SCANS Competencies
1. Drafting Room Procedures					
*1.1 Apply safety policies and procedures [A01]	A1 (same)	Goal 1	H4		
*1.2 Identify drafting terminology [A06]	A6 (same)		E1		3, 5
*1.3 Identify American National Standards Institute, Inc. (ANSI) and International Standards Organization (ISO) standards (terminology) [A03]	A3 (same)		E1		3
*1.4 Identify drafting occupations and related fields [A04]	A4 (same)		F1	A2	3
1.5 Apply record-keeping procedures (filing and record retrieval) [A05]	A5	Goal 1	E1		3
1.6 Identify and apply ergonomic considerations [A07]		Goal 1	H7		3
2. Tools and Equipment					
*2.1 Select proper drawing instruments and equipment to complement the drafting media (e.g., Mylar, vellum) [B01]	B1 (same)	Goal 1		F4	5
*2.2 Demonstrate proper use, care, and adjustment of drawing instruments and equipment and computer equipment [B02]	B2	Goal 1	D8, E1, E2	F4	5
*2.3 Produce copies (e.g., stick-on decals, sepia and blueline copies) [B03]	B3	Goal 1		F4	5
*2.4 Operate and adjust input devices (e.g., mouse, keyboard, digitizer, scanner) [B07]	R2	Goal 1	D8	F4	3, 5
*2.5 Operate and adjust output devices (e.g., printers, plotters, data transfer) [B08]	R2, R3	Goal 1	D8	F4	3, 5
*2.6 Identify and use data storage, retrieval and back-up systems [B09]	R4	Goal 1	D8	F4	3, 5
2.7 Identify operating systems and procedures [B10]		Goal 1	D8	F4	3, 5

Missouri Competency		Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	Pre-Employment/ Work Maturity Skills	VICA/SCANS Competencies
3.	**Basic Drawing Skills**					
*3.1	Lay out drawing [C01]	C1 (same)	Goals 1, 3	D7	F4	3
*3.2	Construct borders and information blocks [C02]	C2 (same)	Goal 3	D7	F4	3
*3.3	Construct freehand sketches [C03]	C3 (same)	Goal 3	D7	F4	3
*3.4	Read and transfer measurements (English and metric) [C04]	C4	Goals 1, 3	D2	F4	3
*3.5	Letter freehand (letters and numerals) [C05]	C5 (same)	Goal 2	D7	F4	3
*3.6	Demonstrate techniques in line construction (e.g., weights, types and uniformity) [C06]	C6	Goals 1, 2	D7	F4	3
*3.7	Construct a reproducible drawing with mechanical pencils [C08]	C8	Goals 1, 2, 3	D7	F4	3
3.8	Construct a reproducible drawing with technical ink pens [C09]	C9	Goals 1, 2, 3	D7	F4	3
*3.9	Perform basic geometric construction (e.g., line dividing, angles, tangents, polygons, arcs) [C11]	D1, D2, D3, D5	Goals 1, 3	D7	F4	3
3.10	Identify and use various annotation methods [C12]		Goals 1, 2, 3	D7	F4	3
4.	**Orthographic Projections: Multiviews [E]**					
*4.1	Identify use and application of orthographic drawings (3rd angle) [E04]	E4 (same)	Goal 1	D7	F4	3
*4.2	Identify 1st and 3rd angle projection drawings [E05]	E5 (same)	Goal 1	D7	F4	3
*4.3	Interpret an orthographic projection (3rd angle) [E01]	E1 (same)	Goals 1, 3	D7	F4	3
*4.4	Sketch multiview drawings (3rd angle) [E02]	E2	Goals 1, 3	D7	F4	3
*4.5	Prepare orthographic drawings (3rd angle) [E03]	E3	Goals 1, 3	D7, D8	F4	3
5.	**Auxiliary Views [F]**					
*5.1	Identify use and application of auxiliary views [F04]	F4 (same)	Goals 1, 3	D7	F4	3
*5.2	Construct primary auxiliary views [F01]	F1 (same)	Goals 1, 3	D7, D8	F4	3
5.3	Construct secondary auxiliary views [F03]	F3 (same)	Goals 1, 3	D7, D8	F4	3
6.	**Descriptive Geometry/Revolutions [I]**					
6.1	Perform graphic solutions of points, lines, and planes	I1, I2, I3	Goals 1, 3	D7	F4	3

Missouri Competency		Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	Pre-Employment/ Work Maturity Skills	VICA/SCANS Competencies
6.2	Solve true length of lines, bearing and slope of lines [I07]		Goals 1, 3	D7	F4	3
6.3	Perform graphic solutions of solids [I04]	I4 (same)	Goals 1, 3	D7	F4	3
6.4	Perform graphic solutions of intersections (e.g., lines, planes and solids) [I05]	I5	Goals 1, 3	D7	F4	3
6.5	Construct drawings using the revolution method [I08]		Goals 1, 3	D7	F4	3
7. Sectional Views/Conventions [G]						
*7.1	Identify and draw standard sectional views [G01]	G1 (same)	Goal 2	D7	F4	3
*7.2	Identify the symbols used to represent different materials [G02]	G2 (same)	Goals 1, 3	D7	F4	3
*7.3	Identify and use cutting planes [G03]	G3 (same)	Goals 1, 2, 3	D7	F4	3
*7.4	Identify and use conventional breaks [G04]	G4 (same)	Goals 1, 2	D7	F4	3
*7.5	Identify use and application of sectional views [G05]	G5 (same)	Goal 1	D7	F4	3
8. Pictorial Drawings [J]						
*8.1	Identify use and application of pictorial drawings [J03]	J3 (same)	Goal 1	D7	F4	3
*8.2	Sketch pictorial drawings [J04]		Goals 1, 2	D7	F4	3
*8.3	Construct axonometric, oblique and perspective drawings [J05]	J2	Goals 1, 2, 3	D7	F4	3
9. Dimensioning and Tolerancing as Applied to Specific Drafting Fields [H]						
*9.1	Construct the lines used to dimension drawings [H02]	H2 (same)	Goals 1, 2	D7	F4	3
*9.2	Identify and apply dimensioning practices [H01]	H1	Goal 1	D7	F4	3
*9.3	Identify and apply tolerancing [H08]	H4	Goal 1	D7	F4	3
9.4	Identify and apply geometric dimensioning and tolerancing techniques [H07]	H6, H7	Goal 1	D7	F4	3
*9.5	Dimension drawing using ANSI and ISO standards [H09]		Goals 1, 2, 3	D7	F4	3
10. Applied Mathematical Skills [S]						
*10.1	Apply basic mathematic principles [S01]	S1 (same)	Goals 1, 3	D2	F4	3
*10.2	Apply basic geometric principles [S02]	S2 (same)	Goals 1, 3	D2	F4	3
*10.3	Apply basic trigonometric principles [S03]	S3 (same)	Goals 1, 3		F4	3

Missouri Competency	Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	Pre-Employment/ Work Maturity Skills	VICA/SCANS Competencies
*10.4 Solve problems using formulas [S04]		Goals 1, 3		F4	3
11. Basic CAD Skills [U]					
*11.1 Create new 2-D drawings [U01]	R3	Goals 1, 2, 3	D7, D8	F4	3, 5
*11.2 Perform drawing setup to applicable standards (e.g., settings, layers, line types and widths) [U02]		Goals 1, 3	D8	F4	3, 5
*11.3 Identify and use view and display commands (e.g., zoom, pan, viewpoints, rotation, shading) [U03]		Goal 1	D8	F4	3, 5
*11.4 Use query commands to extract drawing data (e.g., entity characteristics, distance, area, status) [U04]		Goal 1	D8	F4	3, 5
*11.5 Edit, copy and manipulate drawing entities (e.g., properties, stretch, trimming, scaling) [U05]	R3	Goal 1	D8	F4	3, 5
*11.6 Save, retrieve and manage drawings [U06]	R4	Goal 1	D8	F4	3, 5
*11.7 Dimension drawings [U07]	R3	Goals 1, 2, 3	D7, D8	F4	3, 5
*11.8 Set and change dimensioning variables [U08]	R3	Goals 1, 3	D8	F4	3, 5
*11.9 Enter and edit text [U09]	R3	Goals 1, 2, 3	D8	F4	3, 5
*11.10 Plot drawings to proper scale [U10]	R3	Goals 1, 2, 3	D7, D8	F4	3, 5
11.11 Identify backup and archival methods [U11]	R4	Goal 1	D8	F4	3, 4, 5
11.12 Create, edit and retrieve component/symbol libraries (e.g., groups, blocks, symbols, third-party libraries) [U12]	R4	Goals 1, 3	D8	F4	3, 5
11.13 Identify and apply layering techniques [U13]	R3	Goal 1	D8	F4	3, 5
11.14 Identify methods of sharing drawings (e.g., team projects) [U14]	R4	Goals 1, 3	D8	F4	3, 5
12. Advanced CAD Skills [V]					
12.1 Create 3-D drawings using extrusions and wireframes [V01]		Goals 1, 3	D7, D8	F4	3, 5
12.2 Create surface and solid models [V02]		Goals 1, 3	D8	F4	3, 5
12.3 Create joined and offset surfaces [V03]		Goals 1, 3	D8	F4	3, 5
12.4 Edit solids, curves, and surfaces [V04]		Goals 1, 3	D8	F4	3, 5
12.5 Create 2-D geometry from 3-D models [V05]		Goal 2	D8	F4	3, 5

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Missouri Competency	Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	Pre-Employment/ Work Maturity Skills	VICA/SCANS Competencies
12.6 Import and export various file formats (e.g., DXF, IGES, raster) [V06]	R4	Goal 1	D8	F4	3, 5
12.7 Extract geometric and attribute data (e.g., database and component information) [V07]		Goals 1, 3	D8	F4	3, 5
12.8 Perform customization to improve productivity [V08]		Goals 1, 3	D8	F4	3, 5
12.9 Install and configure software [V09]		Goals 1, 3	D8, E2	F4	3, 5
12.10 Install and configure hardware [V10]		Goals 1, 3	D8, E2	F4	3, 5
12.11 Extract surface and mass properties (e.g., area, perimeter, moments of inertia, centroids) [V11]		Goals 1, 3	D8	F4	3, 5
12.12 Develop geometry using parametric programs [V12]		Goal 1	D8	F4	3, 5
13. Introduction to Production Manufacturing Drawing [O]					
13.1 Identify use and application of threads and fasteners (e.g., bolts, pins, keys) [O04]	O3	Goals 1, 3	D15	F4	3
13.2 Identify manufacturing processes (e.g., machine processes, metal forming, CNC) [O05]		Goals 1, 3	D15	F4	4
13.3 Produce detail drawings applying standard machine fits, finishes and tolerances [O06]	O1	Goals 1, 3	D1, D15	F4	3, 5
13.4 Produce machine assembly drawing [O07]	O1	Goals 1, 3	D7, D8, D15	F4	3, 5
13.5 Apply standard fits, finishes and tolerances to machine drawing [O08]	O1	Goals 1, 3	D1, D15	F4	3, 5
13.6 Develop a parts list [O02]	O2 (same)	Goal 1	D7, D15	F4	3, 5
13.7 Produce drawings for welded component parts [O09]	H1	Goals 1, 3	D6, D7, D15	F4	3, 5
13.8 Produce drawings for metal bending and fabricating [O10]	H1	Goals 1, 3, 4	D6, D7, D15	F4	3, 5
13.9 Produce drawings for non-steel materials [O11]	E3, H1	Goals 1, 3, 4	D6, D7, D15	F4	3, 5
13.10 Produce drawings for CAD/CAM applications [O12]	E3, H1	Goals 1, 3, 4	D6, D7, D15	F4	3, 5
13.11 Produce drawing for cams [O13]	E3, H1	Goals 1, 3, 4	D6, D7, D15	F4	3, 5
13.12 Produce drawing for gears [O14]	E3, H1	Goals 1, 3, 4	D6, D7, D15	F4	3, 5
14. Introduction to Architectural Drawings [K]					
14.1 Construct architectural symbols [K01]	K1 (same)	Goal 1	D7, D15	F4	3

Missouri Competency	Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	Pre-Employment/ Work Maturity Skills	VICA/SCANS Competencies
14.2 Identify architectural design and planning principles [K05]		Goals 1, 3, 4	D7, D15	F4	3
14.3 Identify basic construction terminology and materials [K06]		Goal 1	D7, D15	F4	3
14.4 Produce site plan [K07]		Goals 1, 3, 4	D2, D7, D8, D9, D10, D15	F4	3
14.5 Identify applicable building codes [K08]		Goals 1, 3, 4	D15	F4	3
14.6 Prepare a schedule using a freehand architectural style lettering [K09]		Goals 1, 3, 4	D1, D7, D15	F4	3
14.7 Measure, sketch and draft an as-built floor plan [K10]	K2	Goals 1, 3, 4	D1, D2, D6, D7, D8, D9, D10, D11, D15	F4	3
14.8 Produce typical wall and building sections with necessary details [K11]	K4	Goals 1, 3, 4	D1, D7, D8, D9, D15	F4	3
14.9 Produce floor plans [K02]	K2	Goals 1, 3, 4	D1, D7, D8, D9, D15	F4	3
14.10 Produce elevation drawings [K12]	K2	Goals 1, 3, 4	D1, D7, D8, D9, D15	F4	3
15. Introduction to Residential and Commercial Wiring Drawings [W]					
15.1 Identify electrical symbols [W01]	L1	Goal 1	D7, D15	F4	3
15.2 Identify applicable codes (e.g., IEC, NEC and IEEE) [W02]		Goal 1	D7, D15	F4	3
15.3 Produce wiring schematics [W03]	L2	Goals 1, 3, 4	D1, D7, D8, D9, D15	F4	3, 4
16. Introduction to Electronic Drawings [X]					
16.1 Identify electronic symbols [X01]	L1	Goal 1	D7, D15	F4	3
16.2 Produce electronic/electrical schematics and diagrams [X02]	L2	Goals 1, 3, 4	D1, D7, D8, D9, D15	F4	3, 4
17. Introduction to Pipe/Plumbing Drawings [M]					
17.1 Identify piping symbols, fittings, fixtures and valves [M01]	M1	Goal 1	D7, D15	F4	3

Missouri Competency	Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	Pre-Employment/ Work Maturity Skills	VICA/SCANS Competencies
17.2 Identify applicable codes [M03]		Goal 1	D7, D15	F4	3
17.3 Identify principles of pneumatics and hydraulics [M04]		Goal 1	D15	F4	3
17.4 Produce orthographic drawings [M05]	M2	Goals 1, 3, 4	D1, D7, D8, D9, D15	F4	3
17.5 Produce isometric drawings [M06]	M2	Goals 1, 3, 4	D1, D7, D8, D9, D15	F4	3
18. Introduction to Structural Steel Drawings [N]					
18.1 Identify structural steel shapes [N01]	N1 (same)	Goal 1	D15	F4	3
18.2 Identify applicable codes (OSHA, AWS, SJI and BOCA) [N04]		Goal 1	D15	F4	3
18.3 Identify and apply welding symbols [N05]		Goal 1	D7, D15	F4	3
18.4 Identify open-web joist types and applications [N06]		Goal 1	D7, D15	F4	3
18.5 Produce a steel framing plan drawing [N02]	N2	Goals 1, 3, 4	D6, D7, D8, D15	F4	5
18.6 Produce a detail and assembly drawing (including beam connections) with bill of materials [N03]	N3	Goals 1, 3, 4	D1, D7, D8, D10, D11, D15	F4	3, 5
18.7 Sketch complex connections [N07]		Goals 1, 3	D1, D7, D8, D10	F4	3, 5
19. Introduction to Civil/GIS (Geographic Information System) Drawings [Y]					
19.1 Identify symbols [Y01]	P1	Goal 1	D7, D15	F4	3
19.2 Identify uses of GIS and GPS (global positioning systems) [Y02]		Goal 1	D7, D15	F4	3
19.3 Produce a contour plan [Y03]	P2	Goals 1, 3, 4	D1, D7, D8, D9, D15	F4	3
19.4 Produce a profile drawing [Y04]	P2	Goals 1, 3, 4	D1, D7, D8, D9, D15	F4	3
19.5 Produce a land survey plot from written description [Y05]	P3	Goals 1, 3, 4	D1, D7, D8, D9, D15	F4	3
20. Introduction to Sheet Metal/HVAC Drawings [Q]					
20.1 Identify applicable codes (e.g., ASHRAE) [Q04]		Goal 1	D15	F4	3

Missouri Competency	Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	Pre-Employment/ Work Maturity Skills	VICA/SCANS Competencies
20.2 Produce representative sheet metal drawings [Q02]	Q2 (same)	Goals 1, 3, 4	D1, D2, D6, D7, D8, D9, D15	F4	3
20.3 Identify sheet metal layout procedures [Q03]	Q3 (same)	Goal 1	D7, D15	F4	3
20.4 Identify HVAC symbols [Q05]		Goal 1	D7, D15	F4	3
20.5 Produce sheet metal drawings for CAD/CAM applications [Q06]		Goals 1, 3, 4	D1, D6, D7, D8, D9, D15	F4	3, 5
20.6 Prepare HVAC ductwork plan [Q07]		Goals 1, 3, 4	D1, D2, D7, D8, D9, D15	F4	3, 4
21. Leadership Competencies [T]					
21.1 Demonstrate an understanding of VICA, its structure and activities [T01]	T1	Goal 1			
21.2 Demonstrate an understanding of one's personal values [T02]	T2	Goal 1			
21.3 Perform tasks related to effective personal management skills [T03]	T3	Goal 4	I4		
21.4 Demonstrate interpersonal skills [T04]	T4	Goal 2	I4	G1	2
21.5 Demonstrate etiquette and courtesy [T05]	T5	Goal 2			2
21.6 Demonstrate effectiveness in oral and written communication [T06]	T6	Goal 2		G1	2
21.7 Develop and maintain a code of professional ethics [T07]	T7	Goal 4			
21.8 Maintain a good professional appearance [T08]	T8	Goal 4	I5	F5	
21.9 Perform basic tasks related to securing and terminating employment [T09]	T9	Goals 2, 4			
21.10 Perform basic parliamentary procedures in a group meeting [T10]	T10	Goals 2, 4			2, 4

DRAFTING OCCUPATIONAL SKILLS STANDARDS

Source: *National Occupational Skill Standards for Computer Aided Drafting and Design (CADD).* Washington, DC: Foundation for Industrial Modernization, 1994.

Fundamental Drafting Skills

1.2. **Drafting Skills**
- 1.2.1. Use drawing media and related drafting materials (e.g., papers, vellum, mylar; plotter pens, toner cartridges)
- 1.2.2. Use basic measurement systems (e.g., fractions, decimals, and metric measurements)
- 1.2.3. Add correct annotation to drawing
- 1.2.4. Identify line styles and weights
- 1.2.5. Prepare title blocks and other drafting formats
- 1.2.6. Apply metric and/or dual dimensioning drawing standards
- 1.2.7. Identify and use appropriate standard symbols
- 1.2.8. Reproduction of originals using different methods (e.g., photocopy, plot, blueprint)
- 1.2.9. Create freehand technical sketches

1.3. **Orthographic Projections**
- 1.3.1. Identify, create, and place appropriate orthographic views
- 1.3.2. Identify, create, and place appropriate auxiliary views
- 1.3.3. Identify, create, and place appropriate section views

1.4. **Pictorial Drawings**
- 1.4.1. Identify and create axonometric drawings (e.g., isometric, diametric, trimetric)
- 1.4.2. Identify and create oblique drawings (e.g., cabinet, cavalier)
- 1.4.3. Identify perspective drawings (e.g., 1-point, 2-point, 3-point)

1.5. **Dimensioning**
- 1.5.1. Apply dimensioning rules correctly (e.g., avoid redundant dimensioning, avoid dimensioning to hidden lines)
- 1.5.2. Use correct dimension line terminators (e.g., arrowheads, ticks, slashes)
- 1.5.3. Dimension objects (e.g., lines, arcs, angles, circular)
- 1.5.4. Dimension complex shapes (e.g., spheres, cylinders, tapers, pyramids)
- 1.5.5. Dimension features from a center line
- 1.5.6. Dimension a theoretical point of intersection
- 1.5.7. Use appropriate dual dimensioning standards
- 1.5.8. Use size and location dimension practices
- 1.5.9. Use various dimensioning styles (e.g., Cartesian, polar, ordinate, datum)
- 1.5.10. Place tolerance dimensioning and Geometric Dimensioning and Tolerancing (GD&T) on drawings when appropriate

Fundamental Computer Skills

2.1. **Hardware**
- 2.1.1. Demonstrate proper care of equipment
- 2.1.2. Operate and adjust input devices (e.g., mouse, keyboard, digitizer)
- 2.1.3. Operate and adjust output devices (e.g., printers, plotters, modems)
- 2.1.4. Correct handling and operation of storage media, retrieval, and backup
- 2.1.5. Adjust monitor controls for maximum comfort and usability

2.1.6. Recognize availability of information services (e.g., electronic mail, bulletin boards)

2.2. **Physical and Safety Needs**
- 2.2.1. Demonstrate an understanding of ergonomic considerations (e.g., keyboard position, screen position, lighting)
- 2.2.2. Demonstrate personal safety (e.g., electrical and mechanical hazards)

2.3. **Operating Systems**
- 2.3.1. Start and exit a software program as required
- 2.3.2. Demonstrate proper file management techniques (e.g., copying, deleting)
- 2.3.3. Format floppy disk
- 2.3.4. Identify, create, and use directory structure and change directory paths
- 2.3.5. Demonstrate proper file maintenance and backup procedures
- 2.3.6. Translate, import, and export data files between formats (e.g., IGES, DXF)
- 2.3.7. Use on-line help
- 2.3.8. Save drawings to storage devices

Basic CADD Skills

3.1. **Create**
- 3.1.1. Create new drawing
- 3.1.2. Perform drawing set up
- 3.1.3. Construct geometric figures (e.g., lines, splines, circles, and arcs)
- 3.1.4. Create text using appropriate style and size to annotate drawings
- 3.1.5. Use and control accuracy enhancement tools (e.g., entity positioning methods such as snap and XYZ)
- 3.1.6. Identify, create, store, and use appropriate symbols/libraries
- 3.1.7. Create wireframe/solid models
- 3.1.8. Create objects using primitives
- 3.1.9. Create 2-D geometry from 3-D models
- 3.1.10. Revolve a profile to create a 3-D object
- 3.1.11. Create 3-D wireframe models from 2-D geometry

3.2. **Edit**
- 3.2.1. Utilize geometry editing commands (e.g., trimming, extending, scaling)
- 3.2.2. Utilize non-geometric editing commands (e.g., text, drawing format)

3.3. **Manipulate**
- 3.3.1. Control coordinates and display scale
- 3.3.2. Control entity properties (e.g., color, line type)
- 3.3.3. Use viewing commands (e.g., dynamic rotation, zooming, panning)
- 3.3.4. Use display commands (e.g., hidden line removal, shading)
- 3.3.5. Use standard parts and/or symbol libraries
- 3.3.6. Plot drawings on media using correct layout and scale
- 3.3.7. Use layering techniques
- 3.3.8. Use grouping techniques
- 3.3.9. Minimize file size

3.4. **Analyze**
Use query commands to interrogate database (e.g., entity characteristics, distance, area, status)

3.5. **Dimensioning**
Use associative dimensioning correctly

Advanced CADD Skills

4.1. **Create**
- 4.1.1. Create wireframe and/or solid models

4.1.2. Create non-analytic surfaces using appropriate modeling (e.g., non-analytic: NURBS, B-spline, Gordon, Bezier, Coons)
4.1.3. Create analytic surfaces using appropriate modeling with planes and analytic curves (e.g., conic, cylinder, revolution, ruled)
4.1.4. Create offset surfaces
4.1.5. Find intersection of two surfaces
4.1.6. Create joined surfaces
4.1.7. Create a fillet or blend between two surfaces
4.1.8. Create feature based geometry (e.g., holes, slots, rounds)
4.1.9. Create cut sections
4.1.10. Construct and label exploded assembly drawings
4.1.11. Perform Boolean operations (e.g., union, subtraction, intersection)

4.2. **Edit**
4.2.1. Trim surface
4.2.2. Manipulate surface normals
4.2.3. Extend surface
4.2.4. Edit control points (e.g., surfaces, Bezier)
4.2.5. Modify geometry via Boolean operations
4.2.6. Edit primitives (e.g., moving, copying, resizing)

4.3. Manipulate
4.3.1. Perform axis view clipping
4.3.2. Extract wireframe data from surface/solid geometry
4.3.3. Shade/render object (e.g., reflectivity, opacity)

4.4. **Analyze**
4.4.1. Extract geometric data
4.4.2. Extract attribute data
4.4.3. Identify gaps in non-intersecting surfaces
4.4.4. Obtain surface properties (e.g., area, perimeter, bounded volume)
4.4.5. Obtain mass properties data (e.g., moments of inertia, centroids)

4.5. **CADD Productivity and Work Habits**
4.5.1. Perform customization to improve productivity (e.g., customize menus, function keys, script files, macros)
4.5.2. Manipulate associated non-graphical data
4.5.3. Use template and library files to establish drawing standard presets
4.5.4. Develop geometry using parametric programs

SHOW-ME STANDARDS

The new educational goals and standards are a result of the Outstanding Schools Act of 1993, which calls on Missouri citizens and educators . . . to define appropriate, rigorous expectations for children's learning. Committees of teachers, citizens, parents, lawmakers and state officials have been working on the proposed goals and standards since then.

To lead productive and fulfilling lives and to continue learning, students in Missouri public schools will acquire the knowledge and skills to:

Goal 1: Gather, analyze and apply information and ideas;

Goal 2: Communicate effectively within and beyond the classroom;

Goal 3: Recognize and solve problems; and

Goal 4: Make decisions and act as responsible members of society

Source: "The Show-Me Standards." Jefferson City, MO: Missouri Department of Elementary and Secondary Education, January 1996.

ALL ASPECTS OF THE INDUSTRY

Recent national legislation requires that vocational education programs provide a strong experience in "all aspects of the industry" (AAOI) for industries that students are preparing to enter. AAOI's ultimate goal is to give future workers a sense of the issues involved in the world of work. Such knowledge can empower future workers to make informed decisions about their career paths. This knowledge can also allow workers to make meaningful contributions to the industry, instead of performing mindlessly like another piece of equipment. The main areas of AAOI include:

- Planning
- Management
- Finance
- Technical and Production Skills
- Principles of Technology
- Labor and Community Issues
- Health/Safety/Environment
- Personal Conduct

Duty Bands and Objectives

A. Planning

- A1 Describe why industries respond to customer wants and expectations.
- A2 List differences in how companies deliver products versus delivering services.
- A3 Describe ways a worker can influence company decision-making.
- A4 Identify benefits in anticipating technology and market trend changes.
- A5 Identify an example of how regulatory laws can impact how a business operates.
- A6 Identify an example of how a political organization can impact how a company operates.

B. Management

- B1 Identify key components of a company "mission statement."
- B2 Identify how a corporate "chain of command" works.
- B3 Describe the significance of a company's "corporate culture."
- B4 Describe how a company organizes its departments.
- B5 List typical ways company departments communicate.
- B6 Cite examples of why a worker should adjust to different management styles.
- B7 Cite an example of how companies are dependent on the national economy.
- B8 Cite an example of how a company is dependent upon the local economy.
- B9 Describe the importance of achieving internal and external customer satisfaction.
- B10 Identify examples of how cultural diversity can affect an industry.
- B11 Identify key differences in how private companies and government agencies operate.
- B12 List reasons why written policies are used in industry.
- B13 Identify resources available from professional organizations.
- B14 Identify how roles and responsibilities in a family business are different than in larger companies.
- B15 List benefits a worker can get by participating in meetings.

B16 List key differences in how a family farm operates versus how another small business operates.
B17 Describe how a company's marketing affects all its employees.

C. Finance

C1 List typical ways a business obtains capital.
C2 Describe the importance of accounting in a business.
C3 Describe key implications for a company which grants credit.
C4 Describe how a company estimates and bids for a contract.
C5 Describe how paycheck deductions affect a worker.
C6 Describe the importance of cost containment in a company.

D. Technical and Production Skills

D1 Demonstrate a basic math ability.
D2 Demonstrate the capability to measure quickly and accurately.
D3 Demonstrate the ability to speak and write the English language effectively.
D4 Demonstrate the ability to listen effectively.
D5 Demonstrate the ability to use effective negotiation skills.
D6 Demonstrate the ability to manage time effectively.
D7 Demonstrate the ability to read blueprints and drawings.
D8 Demonstrate the ability to perform basic computer operation.
D9 Describe the importance of deadlines and schedules.
D10 Demonstrate the ability to use team player skills.
D11 Demonstrate the ability to use supervisory and delegation skills.

D12 Demonstrate the ability to utilize good public speaking skills.
D13 Describe the importance of using troubleshooting techniques.
D14 Cite one example of a job that is inter-related with another job.
D15 Demonstrate the ability to obtain technical information.
D16 Identify certification requirements for a specific job.

E. Principles of Technology

E1 Describe the key characteristics of the technology used in your industry.
E2 Describe the importance of analyzing new equipment for possible use.
E3 Describe the importance of continuously upgrading one's job skills.
E4 Describe the importance of adaptability and learning from experience.
E5 Describe the importance of acquiring and analyzing information effectively and making sound decisions.
E6 Describe the importance of cross-training.

F. Labor

F1 Describe the importance of a written job description.
F2 Describe the importance of knowing your rights as a worker.
F3 Describe the role labor organizations play in your industry (if any).
F4 List advantages/disadvantages of hourly and salaried pay.
F5 List differences between being a self-employed worker and a worker employed by a company.
F6 Describe the importance of participating in quality enhancement programs.

F7 Describe the importance of understanding why a worker is asked to occasionally work longer hours.
F8 Describe the importance of cultural sensitivity.

G. Community

G1 Describe the importance of recognizing a worker should contribute special skills through volunteer work.
G2 Identify key ways a company helps its community.
G3 Identify key ways a community helps a company.
G4 Identify an impact of buying outside the community.
G5 Describe how a company's public perception is important.
G6 Describe the importance of providing for the access needs of the physically challenged.

H. Health, Safety and Environment

H1 Describe the importance of complying with federal agency regulations.
H2 Describe why it is important to avoid job-specific health threats.
H3 Read and comprehend major components of a Material Safety Data Sheet.
H4 Identify basic safety training (tornado, fire, first aid) techniques.
H5 Describe the importance of participating in preventive medicine programs.
H6 Describe the importance of handling stress effectively.
H7 Describe the importance of good workplace ergonomics.
H8 Identify any effects weather could have on an industry.
H9 Describe the importance of management's responsibility for a safe workplace.

I. Personal Conduct

I1 Describe the importance of recognizing the dignity of all work.
I2 Describe the importance of producing quality and effective work.
I3 Describe the importance of being fit for duty (no drugs, no alcohol).
I4 Describe the importance of exhibiting good attitude, enthusiasm, integrity.
I5 Describe the importance of exhibiting good grooming and appearance.
I6 Describe the importance of good personal financing.

Source: *All Aspects of the Industry (65-9000-I).* University of Missouri-Columbia: Instructional Materials Laboratory, 1994.

PRE-EMPLOYMENT/WORK MATURITY SKILLS

In 1992, three Missouri agencies co-published the *Pre-Employment and Work-Maturity Competencies: A Guide for Practitioners.* The Missouri competencies identified in the practitioner's guide are endorsed by all three agencies: the Missouri Department of Elementary and Secondary Education, the Department of Labor and Industrial Relations, and the Department of Economic Development. The list includes seven core competencies and related employability skills. Locally developed learner outcomes may, of course, be added, and local groups are encouraged to utilize the identified state competencies for development of their own pre-employment and work maturity skills.

A. Making Career Decisions
- A1. Perform self assessment
- A2. Explore occupational information
- A3. Perform decision-making process

B. Using Labor Market Information
- B1. Identify sources of information
- B2. Use labor market information

C. Preparing a Resume
- C1. Collect resume data
- C2. Develop a resume

D. Completing the Job Application Process
- D1. Prepare letters of inquiry
- D2. Provide accurate educational data
- D3. Provide accurate work history data
- D4. Provide accurate personal data
- D5. Provide accurate reference information
- D6. Fill out job application form

E. Demonstrating Effective Interviewing Skills
- E1. Present proper appearance
- E2. Prepare for interview
- E3. Greet the interviewer
- E4. Participate in the interview
- E5. Respond to interview closure
- E6. Prepare a letter of follow-up

F. Demonstrating Knowledge of the Proper Work Attitudes and Behaviors
- F1. Be dependable
- F2. Be punctual
- F3. Maintain a positive attitude and behavior
- F4. Complete tasks effectively with or without supervision
- F5. Practice good grooming and personal hygiene
- F6. Recognize legal issues in the workplace

G. Demonstrating Knowledge of Effective Interpersonal Skills
- G1. Communicate with others
- G2. Maintain relationships with others

SCANS COMPETENCIES

SCANS *foundation skills* identified by the U.S. Department of Labor describe generic skills needed by nearly everyone. The SCANS *competencies*, however, are more specific in nature and are listed below. (SCANS is the acronym for the Secretary [of Labor]'s Commission on Achieving Necessary Skills.) National VICA's *Total Quality Curriculum* incorporates SCANS competencies and Total Quality Management (TQM) principles in a 17-module set of activities.

1. **Resources**
   - Allocates time
   - Allocates money
   - Allocates material and facility resources
   - Allocates human resources

2. **Interpersonal**
   - Participates as a member of a team
   - Teaches others
   - Serves clients/customers
   - Exercises leadership
   - Negotiates to arrive at a decision
   - Works with cultural diversity

3. **Information**
   - Acquires and evaluates information
   - Organizes and maintains information
   - Interprets and communicates information
   - Uses computers to process information

4. **Systems**
   - Understands systems
   - Monitors and corrects performance
   - Improves and designs systems

5. **Technology**
   - Selects technology
   - Applies technology to task
   - Maintains and troubleshoots equipment

Employability Competencies

Personal Characteristics

Directions: Rate the student by checking the appropriate number on each scale. The ratings should be based on your **observation of the student** rather than grades given in class.

Rating Scale: 3 Above Average
2 Average
1 Below Average

3	2	1

Personal Characteristics

1. **Relations with others**
   (effectiveness in working with students, instructors, and others; cooperation; shows respect)
2. **Dependability**
   (attendance, punctuality; adherence to schedules and deadlines; consistency and results; perseverance)
3. **Work attitudes**
   (willingness to learn; willingness to accept and profit from evaluation; enthusiasm; initiative; commitment; pride in work)
4. **Communication**
   (listening, speaking, and nonverbal skills; effectiveness in communicating with students, teachers, and others)
5. **Personal hygiene/grooming**
   (personal health care and cleanliness; dresses and maintains self appropriately)

Others (specify):

_____

_____

_____

Job Seeking Techniques

Directions: Evaluate the student by checking the appropriate number or letter to indicate the degree of competency. The rating for each task should reflect **employability readiness** rather than the grades given in class.

Rating Scale: 3 Above Average
2 Average
1 Below Average
N No Exposure

3	2	1	N

Job Seeking Techniques

1. Apply information about self and job opportunities in career decision making
2. Write a resume
3. Prepare a job application form
4. Write letters of application and acceptance
5. Arrange for personal references
6. Apply job search techniques
7. Arrange a job interview
8. Apply job interview techniques
9. Evaluate job offers (actual or simulated)

Others (specify):

_____

_____

_____

Entrepreneurship Awareness

Directions: Evaluate the student by checking the appropriate number or letter to indicate the degree of competency. The rating for each task should reflect **employability readiness** rather than the grades given in class.

Rating Scale: 3 Above Average
2 Average
1 Below Average
N No Exposure

3	2	1	N

Entrepreneurship Awareness

1. Describe five characteristics of a free enterprise economic system (ownership of property, profit motive, risk taking, competition, supply and demand)
2. Name four forms of business ownership (sole proprietorship, partnership, corporation, cooperative)
3. Describe advantages and disadvantages of small business ownership
4. Identify steps necessary to start a business (evaluate need, site selection, marketing plan, financial plan, management plan)
5. Identify business opportunities related to training
6. Identify personal traits of the entrepreneur (versatility, aspirations, energy, integrity, adaptability, etc.)

Others (specify):

_____

_____

_____

Competency Profile

Instructor: _____

Instructional Program: _____

_____

School: _____

School Address: _____

_____

Student: _____

Address: _____

_____

Telephone: _____

Social Security Number: _____

IN CASE OF EMERGENCY, CONTACT

Name: _____

Telephone: _____

Family Doctor: _____

Telephone: _____

1-00

Date of Enrollment: _____

Date of Withdrawal: _____

Date of Completion: _____

Total Hours Absent: _____

Total Instructional Hours: _____

Total On-The-Job Training Hours: _____

On-The-Job Training/Work Experience

Duration of Employment	Job Title	Job Description	Supervisor's Name	Name/Address of Employer	Telephone

The following profile ratings represent the knowledges, skills, and attitudes that this student has demonstated at a given time under given conditions. It does not necessarily represent certification of future abilities.

This project was supported in whole or in part by funds from the Department of Elementary and Secondary Education, Division of Vocational and Adult Education. However, the opinions expressed herein do not necessarily reflect the position or policies of the Missouri Department of Elementary and Secondary Education, Division of Vocational and Adult Education, and no official endorsement should be inferred.

Name: _____

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Directions: Evaluate the student by checking the appropriate number or letter to indicate the degree of competency. The rating for each task should reflect **employability readiness** rather than the grades given in class.

Rating Scale:
3 Mastered - can work independently with no supervision
2 Requires Supervision - can perform job completely with limited supervision
1 Not Mastered - requires instruction and close supervision
N No Exposure - no experience or knowledge in this area

(IBM) 2-98

NOTES:

* = Core competencies (essential for the first day on the job)

Numbers in brackets (e.g., A01) represent the IDs used in computerized tracking software.

3	2	1	N	1. Personal Safety	EIA/EIF
				*1. Identify various types, purposes and operation of fire extinguishers [A01]	
				*2. Identify electrical hazards [A02]	
				*3. Identify and practice shop safety, including eye protection and environmental hazards [A03]	A.02
				*4. Identify and practice safe soldering methods [A04]	A.05
				*5. Demonstrate safe and proper use of hand tools [A05]	A.04
				*6. Identify hazard of RF radiation devices [A06]	
				*7. Demonstrate safe and proper use of AC line-operated equipment (e.g., isolation transformers, grounding, leakage current testing, GFI) [A07]	C.06, C.07
				Other:	

3	2	1	N	2. Fundamentals of Electronics	A.06, B.01, B.04
				*1. Evaluate and test sources of DC and AC signals and power [B21]	B.05, C.01-C.05, C.15
				*2. Apply Ohm's law [B22]	B.03, B.24, C.15
				*3. Evaluate and test DC series circuits [B23]	B.05, B.08-B.10
				*4. Evaluate and test DC parallel circuits [B24]	B.05, B.11, B.12, B.13
				*5. Evaluate and test DC series-parallel circuits [B25]	B.05, B.14-B.16, B.18-B.20
				*6. Evaluate and test bridge circuits [B26]	B.14-B.17
				*7. Evaluate and test magnetic and electromagnetic devices [B27]	B.05, B.06, C.15
				*8. Evaluate and test transformers [B28]	C.06, C.14-C.17
				*9. Evaluate and test capacitors [B13]	B.07, C.08-C.10
				*10. Evaluate and test inductors [B14]	B.07, B.08, C.11-C.13
				*11. Evaluate and test resistive devices [B12]	A.10
				*12. Evaluate and test basic circuit controls (e.g., switches, fuses, circuit breakers) [B29]	
				*13. Evaluate and test AC series R/L/C (resistance-inductance-capacitance) and filter circuits [B30]	C.21-C.29
				*14. Evaluate and test AC parallel R/L/C and filter circuits [B31]	B.13, C.21-C.29
				*15. Evaluate and test time constants [B32]	B.21-B.23
				Other:	

3	2	1	N	3. Power Supplies	
	93			*1. Identify safety hazards associated with power supplies [C10]	
				*2. Evaluate and test batteries [C11]	B.02

3	2	1	N	10. Microprocessors/Microcontrollers	EIA/EIF
				*1. Evaluate and test microprocessor bus signals [P01]	G.03-G.05
				*2. Evaluate and test IO devices [P02]	G.01-G.02
				*3. Evaluate and test memory devices [P03]	G.06-G.07
				*4. Evaluate and test dedicated microcontrollers [P04]	
				Other:	

3	2	1	N	11. Circuit Construction Techniques	
				*1. Construct multistage circuits according to schematic diagrams [M01]	A.07, A.08
				*2. Desolder defective components and solder replacement components [M03]	A.05
				Other:	

3	2	1	N	12. Troubleshooting	
				*1. Perform logical steps of troubleshooting on electronic systems [N06]	A.03, A.12
				Other:	

3	2	1	N	13. Telecommunications	
				1. Test and repair phase-locked loop circuits [Q01]	C.31, C.32
				2. Test and repair IF (intermediate frequency) circuits [Q02]	E.04-E.06
				3. Test and repair RF (radio frequency) circuits [Q03]	E.24-E.26
				4. Test and repair modulation systems [Q04]	E.27, E.28
				5. Test and repair active filter circuits [Q05]	E.18
				6. Test and repair transmitters [Q06]	
				7. Test and repair receivers [Q07]	
				8. Test and align antennas [Q08]	
				9. Test and repair telephone systems [Q09]	
				10. Test and repair personal communication systems (PCS) [Q10]	
				11. Install, test and repair satellite receivers [Q11]	
				12. Operate frequency counters [Q12]	
				Other:	

3	2	1	N	14. Audio-Video Technology	
				1. Test and repair digital audio record/play systems [R01]	
				2. Test and repair analog audio record/play systems [R02]	
				3. Test and repair digital video record/play systems [R03]	
				4. Test and repair analog video record/play systems [R04]	
				5. Test and repair digital video display systems [R05]	
				6. Test and repair analog video display systems [R06]	
				7. Test and repair audio reproduction systems [R07]	

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3	2	1	N	4. Semiconductor Devices	
				*1. Evaluate and test diodes [D13]	D.01, D.02, D.05-D.08
				*2. Evaluate and test transistors (e.g., BJTs and FETs) [D14]	D.03, D.04
				*3. Evaluate and test thyristors (e.g., SCRs, TRIACs and DIACs) [D15]	D.15-D.17
				*4. Select semiconductors using specification sheets and substitution guides [D16]	A.07, partial A.09, E.10-E.12
				*5. Demonstrate proper techniques for handling and replacing semiconductors [D17]	
				Other:	

3	2	1	N	5. Amplifiers	
				*1. Test and repair transistor switching circuit [E09]	
				*2. Test and repair bipolar transistor amplifier circuits [E04]	D.12-D.14, E.13-E.15
				*3. Test and repair FET amplifier circuits [E05]	D.12-D.14
				*4. Test and repair operational amplifier circuit [E06]	E.10-E.12
				*5. Test and repair multistage amplifiers [E10]	E.01-E.03, F.03, F.04
				Other:	

3	2	1	N	6. Frequency Generation	
				*1. Test and repair oscillators [F05]	E.20, E.21
				*2. Test and repair pulse generators and multivibrators [F08]	E.20, E.21, F.17-F.19
				Other:	

3	2	1	N	7. Test Equipment	
				*1. Measure voltage, time and frequency using an oscilloscope [H01]	partial A.09, C.02, C.03
				*2. Measure voltage, current and resistance using multimeters (VOM, EVM, DVM) [H02]	
				*3. Operate signal generators: audio, RF, function [H03]	
				Other:	

3	2	1	N	8. Optical Electronics	
				*1. Test common optical devices (e.g., photodetectors, emitters, optical isolators and LEDs) [J09]	D.09
				Other:	

3	2	1	N	9. Digital Logic Applications	
				*1. Identify and convert number systems and codes (e.g., binary, hex, ASCII and BCD) [K01]	
				*2. Test the operation of basic logic gates [K02]	F.01, F.05-F.07
				*3. Interpret truth tables of logic circuits [K03]	F.05-F.07
				*4. Test operation of clock and timing circuits [K13]	
				*5. Test combinational logic circuits for a given application [K07]	D.09-D.11, F.08-F.10, F.22, F.23, F.26, F.27, F.30-F.33
				*6. Test counter and controller circuits for sequential logic applications [K09]	F.11-F.16
				*7. Interpret information on digital data sheets [K11]	A.07, partial A.09
				*8. Test the operation of A/D and D/A converters [K12]	F.24, F.25
				Other:	

3	2	1	N	15. Networks	
				1. Test and repair transmitters and receivers (photonic and electronic) [S01]	E.22, E.23
				2. Test and repair transmission mediums [S02]	
				3. Install, test and repair physical layer of a network [S03]	
				4. Install protocol stack [S04]	
				5. Install network software [S05]	
				Other:	

3	2	1	N	16. Computer Systems	
				1. Test and repair microcomputers to board level [T01]	H.01, H.02
				2. Test computer component functions (e.g., microprocessor, memory, I/O, etc.) [T02]	
				3. Install and configure hardware components (e.g., drives, cards, memory expansion, motherboard, disk interfaces) [T03]	
				4. Install and configure operating system software [T04]	H.04
				5. Install and configure supporting software [T05]	H.04
				6. Test and maintain computer peripherals [T06]	H.03, H.05
				Other:	

3	2	1	N	17. Industrial Electronics	
				1. Create simple ladder logic diagrams/programs [U01]	
				2. Install and configure programmable logic controllers [U02]	
				3. Test and repair motor control systems (e.g., starters and control wiring, overcurrent protection) [U03]	
				4. Test and repair variable-speed motor drives [U04]	
				5. Identify and test sensors [U05]	
				6. Test and repair solid-state power controls [U06]	
				7. Test, repair and maintain computer-controlled systems (e.g., CNC and robotics) [U07]	
				Other:	

3	2	1	N	18. Leadership Competencies**	
				1. Demonstrate an understanding of VICA, its structure and activities [O01]	
				2. Demonstrate an understanding of one's personal values [O02]	
				3. Perform tasks related to effective personal management skills [O03]	
				4. Demonstrate interpersonal skills [O04]	
				5. Demonstrate etiquette and courtesy [O05]	
				6. Demonstrate effectiveness in oral and written communication [O06]	
				7. Develop and maintain a code of professional ethics [O07]	
				8. Maintain a good professional appearance [O08]	
				9. Perform basic tasks related to securing and terminating employment [O09]	
				10. Perform basic parliamentary procedures in a group meeting [O10]	

**(Note: These competencies are addressed in the Missouri VICA Curriculum Guide lessons.)

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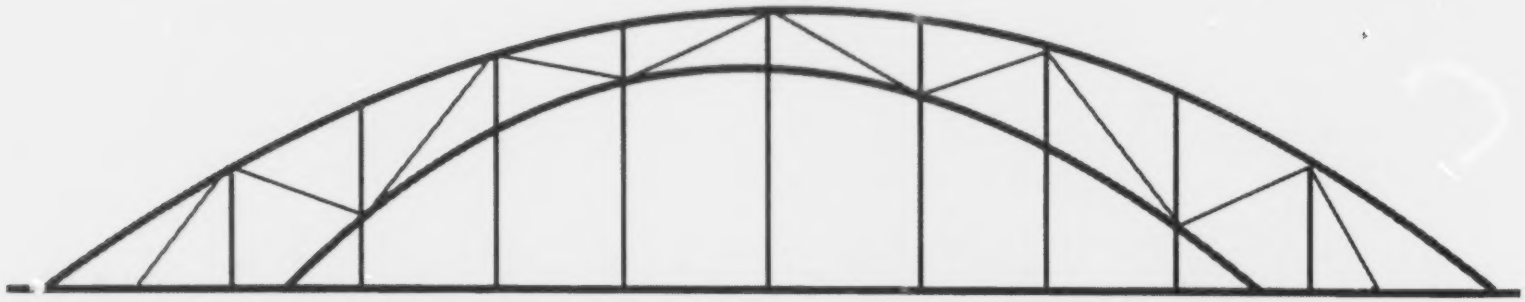
Performance Indicators for Electronics:

A Bridge to Selected Instructional Materials



• National Skill Standards • Missouri Competencies • Show-Me Standards
• All Aspects of the Industry Objectives • Pre-Employment/Work Maturity Skills
• VICA/SCANS Competencies

Instructional Materials Laboratory
University of Missouri-Columbia

February 1996

INTRODUCTION

This curriculum project includes two parts: an updated Electronics competency profile and this performance indicator document. The updated profile contains more information than before. It is cross-referenced to national skill standards (see page 11); core/essential skills are indicated by an asterisk (*); and task IDs for VAMS (Missouri's Vocational Administrative Management System) are shown in brackets. In general, competencies beginning with "evaluate and test" refer to components, while competencies starting with "test and repair" are at the circuit level.

The Performance Indicator Chart connects technical electronics skills with other important, but more general, skills needed by students. This document also provides instructors and administrators with links between newly updated electronics competencies and (1) previous Mo. competencies, (2) Show-Me Standards for students in Missouri public schools, (3) All Aspects of the Industry objectives, (4) Pre-Employment/Work Maturity Skills, and (5) SCANS competencies (addressed in National VICA's *Total Quality Curriculum).* These sets of skills are listed after the Performance Indicator Chart.

To use the Electronics Performance Indicator Chart, consider the following example. Duty bands (umbrella-like categories for competencies) are in **bold** type and shaded.

	Page 16 ↘	Page 17 ↘	Page 20 ↘	Page 21 ↘
Missouri Competency	**Previous Mo. Competencies**	**Show-Me Standards**	**AAOI Objectives**	**Pre-Employment/ Work Maturity Skills**	**VICA/SCANS Competencies**
1. Personal Safety					
*1.3 Identify and practice shop safety, including eye protection and environmental hazards [A03]	A3	Goal 4	A5, H1, H4		3, 5

The second column (Previous Mo. Competencies) is helpful for anyone with curriculum tied to the previous Missouri competency list. As indicated by the chart, competency #3 in Personal Safety is related to previous competency A3. Personal Safety #3 is also related to the fourth Show-Me Standard, AAOI Objectives A5, H1 and H4, and so on.

For more detail, obtain or contact the following resources.

- *Raising the Standard: Electronics Technician Skills for Today and Tomorrow.* Washington, DC: Electronics Industries Association and Electronic Industries Foundation, 1994.* Contact:
  Electronic Industries Foundation, 919 18th Street, NW, Suite 900, Washington, DC 20006, 202/955-5810, FAX 202/955=5837.
- Electronics competency profile (70-5000-C), test-item bank (70-5000-E) and curriculum guide (70-5000-I/S/W). Contact:
  Instructional Materials Laboratory, 2316 Industrial Drive, Columbia, MO 65211, 800/669-2465, FAX 573/882=1992.

- Pre-Employment/Work-Maturity Skills Instructional Resource Guide (30-6000-I). University of Missouri-Columbia: Instructional Materials Laboratory, 1992. Contact: IML (see above)
- *All Aspects of the Industry (65-9000-I).* University of Missouri-Columbia: Instructional Materials Laboratory, 1994. Contact: IML (see above)
- *Learning a Living: A Blueprint for High Performance (A SCANS Report for America 2000).* Washington, DC, U.S. Department of Labor, 1992.*
- *Total Quality Curriculum.* Leesburg, VA: National VICA, 1993.* Contact: Education Dept., National VICA, PO Box 3000, Leesburg, VA 22075, 800/321-VICA (8422).
- VIMS/VAMS Support Center, 324 Townsend Hall, UMC, Columbia, MO 65211, 573/882-2951, FAX 573/884=5455.

*These resources are available to Missouri educators for free loan from the Missouri Vocational Resource Center (MVRC), University of Missouri-Columbia, 8 London Hall, Columbia, MO 65211 (800/392-7217, FAX 573/882=9935).

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ELECTRONICS PERFORMANCE INDICATORS

NOTES: Instructional notes (which do not appear on the final competency list) are listed **with a dash (–)** under some competencies.
The numbers in brackets represent IDs used in computerized tracking software.
* = Core competencies (essential for the first day on the job)

Missouri Competency		Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	Pre-Employment/ Work Maturity Skills	VICA/SCANS Competencies
1. Personal Safety						
*1.1	Identify various types, purposes and operation of fire extinguishers [A01]	A1 (same)	Goal 4	H4		3
*1.2	Identify electrical hazards [A02]	A2 (same)	Goal 1	H2, H4		3
*1.3	Identify and practice shop safety, including eye protection and environmental hazards [A03] --Awareness of applicable OSHA	A3	Goal 4	A5, H1, H4		3, 5
*1.4	Identify and practice safe soldering methods [A04]	A4 (same)	Goals 1, 4	H2, H3	F4	3, 5
*1.5	Demonstrate safe and proper use of hand tools [A05]	A5 (same)	Goal 4	H2	F4	5
*1.6	Identify hazard of RF radiation devices [A06]	A6 (same)	Goal 1			3
*1.7	Demonstrate safe and proper use of AC line-operated equipment (e.g., isolation transformers, grounding, leakage current testing, GFI) [A07]	A7	Goal 1	H2	F4	5
2. Fundamentals of Electronics						
*2.1	Evaluate and test sources of DC and AC signals and power [B21]	B5, B6, B7	Goal 1	D1, D15	F4	3, 4, 5
*2.2	Apply Ohm's law [B22] --Include power laws	B8	Goals 1, 3	D1	F4	3
*2.3	Evaluate and test DC series circuits [B23]	B8, B10, B15, H2	Goal 1	D1, D2, D15	F4	3, 5
*2.4	Evaluate and test DC parallel circuits [B24]	B8, B10, B15, H2	Goal 1	D1, D2, D15	F4	3, 5
*2.5	Evaluate and test DC series-parallel circuits [B25] --Effects of loads on voltage dividers	B15, H2	Goal 1	D1, D2, D15	F4	3, 5
*2.6	Evaluate and test bridge circuits [B26]	B15	Goal 1	D1, D2, D15	F4	3, 5
*2.7	Evaluate and test magnetic and electromagnetic devices [B27] --Motors	B3, B4, L1	Goal 1	D1, D2, D15	F4	3, 5

Missouri Competency		Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	Pre-Employment/ Work Maturity Skills	VICA/SCANS Competencies
*2.8	Evaluate and test transformers [B28]	C1, C2	Goal 1	D1, D2, D15	F4	3, 5
*2.9	Evaluate and test capacitors [B13] --Concepts of capacitance and reactance --Selection and replacement	B9, B13	Goal 1	D1, D2, D15	F4	3, 5
*2.10	Evaluate and test inductors [B14]	B10, B14	Goal 1	D1, D2, D15	F4	3, 5
*2.11	Evaluate and test resistive devices [B12]	B12	Goal 1	D1, D2, D15	F4	3, 5
*2.12	Evaluate and test basic circuit controls (e.g., switches, fuses, circuit breakers) [B29]		Goal 1	D2, D15	F4	3, 4, 5
*2.13	Evaluate and test AC series R/L/C (resistance-inductance-capacitance) and filter circuits [B30] --Identify the circuit, describe its behavior and test its performance --Bandwidth, frequency, phase and amplitude	B11, B15, B19, B20	Goal 1	D1, D2, D15	F4	3, 4, 5
*2.14	Evaluate and test AC parallel R/L/C and filter circuits [B31] --Including resonant circuits	B11, B15, B19, B20	Goal 1	D1, D2, D15	F4	3, 4, 5
*2.15	Evaluate and test time constants [B32]	B18	Goal 1	D1, D2, D15	F4	3, 5
3. Power Supplies						
*3.1	Identify safety hazards associated with power supplies [C10]		Goal 1	H2, H3, H4		3
*3.2	Evaluate and test batteries [C11]		Goal 1	D2, E5	F4	3, 4, 5
*3.3	Test and repair linear power supplies [C12]	C3, C4, C8, C9	Goal 1	D13, E5	F4	3, 4, 5
*3.4	Test and repair linear regulator circuits [C13] --Including zener diodes and IC regulators	C5, C6, C9	Goal 1	D2, D13, E5	F4	3, 4, 5
4. Semiconductor Devices						
*4.1	Evaluate and test diodes [D13] -- Rectifiers, varactors, zeners	B2, C3, D1, D2, D13	Goal 1	D2, D15	F4	3, 5
*4.2	Evaluate and test transistors (e.g., BJTs and FETs) [D14]	D1, D3, D5, D6, D14	Goal 1	D2, D15	F4	3, 5
*4.3	Evaluate and test thyristors (e.g., SCRs, TRIACs and DIACs) [D15]	D1, D7, D8, D9, D10, D11, D15	Goal 1	D2, D15	F4	3, 5

Missouri Competency		Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	Pre-Employment/ Work Maturity Skills	VICA/SCANS Competencies
*4.4	Select semiconductors using specification sheets and substitution guides [D18]	C3, D16, M4	Goals 1, 3	D2, D15	F4	3
*4.5	Demonstrate proper techniques for handling and replacing semiconductors [D17] --Static precautions, heat sinks, lead dress	B1, D17	Goals 1, 3	D7, E5	F4	3
5. Amplifiers						
*5.1	Test and repair transistor switching circuit [E09]		Goals 1, 3	D2, D6, D7, D13, D15, I2	F4	3
*5.2	Test and repair bipolar transistor amplifier circuits [E04] --Including small signal and power amplifiers	E1, E4	Goals 1, 3		F4	3
*5.3	Test and repair FET amplifier circuits [E05]	E2, E5	Goals 1, 3		F4	3
*5.4	Test and repair operational amplifier circuit [E06]	D1, E3, E6	Goals 1, 3		F4	3
*5.5	Test and repair multistage amplifiers [E10] --Including discrete and integrated amplifiers	D1, E4, E5, E6, E7, E8	Goals 1, 3		F4	3
6. Frequency Generation						
*6.1	Test and repair oscillators [F05]	F1, F2, F5	Goals 1, 3	D2, D6, D7, D9, D13, D15, E1, E3, E4, E5, I2	F4	3, 4
*6.2	Test and repair pulse generators and multivibrators [F08]	F7	Goals 1, 3		F4	3, 4
7. Test Equipment						
*7.1	Measure voltage, time and frequency using an oscilloscope [H01]	H1	Goals 1, 3	D2, D7, D13, D15, E1, E3, E4, E5, I2	F4	3, 4, 5
*7.2	Measure voltage, current and resistance using multimeters (VOM, EVM, DVM) [H02]	H2	Goals 1, 3		F4	3, 4, 5
*7.3	Operate signal generators: audio, RF, function [H03]	H3	Goals 1, 3		F4	3, 4, 5
8. Optical Electronics						
*8.1	Test common optical devices (e.g., photodetectors, emitters, optical isolators and LEDs) [J09]	J1-4, J6	Goal 1	D15	F4	3
9. Digital Logic Applications						
*9.1	Identify and convert number systems and codes (e.g., binary, hex, ASCII and BCD) [K01]	K1	Goal 1	D1, D2, D7, D13, D15	F4	3, 4

Missouri Competency	Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	Pre-Employment/ Work Maturity Skills	VICA/SCANS Competencies
*9.2 Test the operation of basic logic gates [K02] --Includes logic families (e.g., TTL and CMOS)	K2, K4	Goal 1	D2, D7, D13, D15	F4	3, 4, 5
*9.3 Interpret truth tables of logic circuits [K03]	K3	Goal 1	D2, D7, D13	F4	3, 4
*9.4 Test operation of clock and timing circuits [K13]		Goal 1	D2, D7, D13, D15	F4	3
*9.5 Test combinational logic circuits for a given application [K07] --Encoders, decoders, multiplexers, demultiplexers, display circuits	K4	Goal 1	D2, D7, D13, D15	F4	3
*9.6 Test counter and controller circuits for sequential logic applications [K09] --Flip-flops, counters, shift registers	K8, K9, L6	Goal 1	D2, D7, D13, D15	F4	3
*9.7 Interpret information on digital data sheets [K11]	K11	Goal 1	D2, D7, D13, D15	F4	3, 4
*9.8 Test the operation of A/D and D/A converters [K12]		Goal 1	D2, D7, D13	F4	3, 4
10. Microprocessors/Microcontrollers					
*10.1 Evaluate and test microprocessor bus signals [P01]		Goal 1	D2, D7, D13, D15	F4	3, 4
*10.2 Evaluate and test IO devices [P02]	I7, I8	Goal 1	D2, D7, D13, D15	F4	3, 4
*10.3 Evaluate and test memory devices [P03]		Goal 1	D2, D7, D13, D15	F4	3, 4
*10.4 Evaluate and test dedicated microcontrollers [P04]		Goal 1	D2, D7, D13, D15	F4	3, 4
11. Circuit Construction Techniques					
*11.1 Construct multistage circuits according to schematic diagrams [M01] --Breadboard circuits by any method --Using circuits on Missouri competency profile	B17, M1, M2	Goal 1	D7	F4	3, 4, 5
*11.2 Desolder defective components and solder replacement components [M03] --Surface-mount technology --Printed circuit board minor repair	B16, M3, M4, M5	Goals 1, 3		F4	

Missouri Competency	Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	Pre-Employment/ Work Maturity Skills	VICA/SCANS Competencies
12. Troubleshooting					
*12.1 Perform logical steps of troubleshooting on electronic systems [N06]	N1, N2, N3, N4, N5	Goal 1	D13	F4	3, 4, 5
13. Telecommunications					
13.1 Test and repair phase-locked loop circuits [Q01]	F3, F6	Goals 1, 3	D13	F4	3, 4, 5
13.2 Test and repair IF (intermediate frequency) circuits [Q02]		Goals 1, 3	D13, E5	F4	3, 4, 5
13.3 Test and repair RF (radio frequency) circuits [Q03]		Goals 1, 3	D13, E5	F4	3, 4, 5
13.4 Test and repair modulation systems [Q04]		Goals 1, 3	D13, E5	F4	3, 4, 5
13.5 Test and repair active filter circuits [Q05]		Goals 1, 3	D13, E5	F4	3, 4, 5
13.6 Test and repair transmitters [Q06]	G2, G3	Goals 1, 3	D13, E5	F4	3, 4, 5
13.7 Test and repair receivers [Q07]	G1, G3	Goals 1, 3	D13, E5	F4	3, 4, 5
13.8 Test and align antennas [Q08]	G4	Goals 1, 3	D13, E5	F4	3, 4, 5
13.9 Test and repair telephone systems [Q09]		Goals 1, 3	D13, D15, E5	F4	3, 4, 5
13.10 Test and repair personal communication systems (PCS) [Q10]		Goals 1, 3	D13, D15, E5	F4	3, 4, 5
13.11 Install, test and repair satellite receivers [Q11]	G3	Goals 1, 3	D13, D15, E2, E5	F4	3, 4, 5
13.12 Operate frequency counters [Q12]	H4	Goal 1		F4	3, 4
14. Audio-Video Technology					
14.1 Test and repair digital audio record/play systems [R01]		Goals 1, 3	D13, E5	F4	3, 4, 5
14.2 Test and repair analog audio record/play systems [R02] --Tape/disk recorders/players		Goals 1, 3	D13, E5	F4	3, 4, 5
14.3 Test and repair digital video record/play systems [R03]		Goals 1, 3	D13, E5	F4	3, 4, 5
14.4 Test and repair analog video record/play systems [R04] --VCRs, video disk		Goals 1, 3	D13, E5	F4	3, 4, 5
14.5 Test and repair digital video display systems [R05]		Goals 1, 3	D13, E5	F4	3, 4, 5
14.6 Test and repair analog video display systems [R06] --Television		Goals 1, 3	D13, E5	F4	

Missouri Competency	Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	Pre-Employment/ Work Maturity Skills	VICA/SCANS Competencies
14.7 Test and repair audio reproduction systems [R07] --Power amplifiers, public address systems		Goals 1, 3	D13, E5	F4	3, 4, 5
14.8 Test and repair video reproduction systems [R08] --Projection video systems		Goals 1, 3	D13, E5	F4	3, 4, 5
14.9 Test and repair interactive video systems [R09]		Goals 1, 3	D13, E5	F4	3, 4, 5
14.10 Test and repair interactive audio systems [R10]		Goals 1, 3	D13, E5	F4	3, 4, 5
15. Networks					
15.1 Test and repair transmitters and receivers (photonic and electronic) [S01] --Data transducers (ex.: RF to light) --For use with coax, fiber, etc.		Goals 1, 3	D13, E5	F4	3, 5
15.2 Test and repair transmission mediums [S02] --Refers to type of cabling, RF, infrared, microwave		Goals 1, 3	D13, E5	F4	3, 5
15.3 Install, test and repair physical layer of a network [S03] --Bridges, routers, wiring, computers, hubs, topology (hardware)		Goals 1, 3	D8, D13, E5	F4	3, 4, 5
15.4 Install protocol stack [S04]		Goals 1, 3	D8	F4	3, 5
15.5 Install network software [S05]		Goals 1, 3	D8	F4	3, 5
16. Computer Systems					
16.1 Test and repair microcomputers to board level [T01] --Operate diagnostic software --Replace defective modules	I9	Goals 1, 3	D7, D8, D13, E5		3, 4, 5
16.2 Test computer component functions (e.g., microprocessor, memory, I/O, etc.) [T02] --Concepts of CPU, Memory, I/O		Goals 1, 3	D8, D15	F4	3, 5
16.3 Install and configure hardware components (e.g., drives, cards, memory expansion, motherboard, disk interfaces) [T03] --Install boards (I/O, serial-parallel, FAX-modem, analog), driver software, jumpers, configuration	I9	Goals 1, 3	D7, D8, D15	F4	3, 4, 5
16.4 Install and configure operating system software [T04]	I3, I6	Goals 1, 3	D8, D15	F4	3, 4, 5
16.5 Install and configure supporting software [T05] --Driver software, etc.	I4, I6	Goal 1	D8, D15	F4	

Missouri Competency	Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	Pre-Employment/ Work Maturity Skills	VICA/SCANS Competencies
16.6 Test and maintain computer peripherals [T06] --Printers, scanners, monitors, LCD displays, pointing devices, keyboards	I9	Goals 1, 3	D8, D15	F4	3, 4, 5
17. Industrial Electronics					
17.1 Create simple ladder logic diagrams/programs [U01]		Goal 1	D8	F4	3, 4
17.2 Install and configure programmable logic controllers [U02] --Including I/O modules and interfaces --Data communication	L9	Goals 1, 3	D8, D15	F4	3, 5
17.3 Test and repair motor control systems (e.g., starters and control wiring, overcurrent protection) [U03]	L2, L4, L7	Goals 1, 3	D13, E5	F4	3, 4, 5
17.4 Test and repair variable-speed motor drives [U04]	L8	Goals 1, 3	D13, E5	F4	3, 5
17.5 Identify and test sensors [U05]		Goals 1, 3	D15	F4	3, 5
17.6 Test and repair solid-state power controls [U06]		Goals 1, 3	D13, E5	F4	3, 5
17.7 Test, repair and maintain computer-controlled systems (e.g., CNC and robotics) [U07]		Goals 1, 3	D13, E5	F4	3, 5
18. Leadership Competencies					
18.1 Demonstrate an understanding of VICA, its structure and activities [O01]	N1				4
18.2 Demonstrate an understanding of one's personal values [O02]	N2				
18.3 Perform tasks related to effective personal management skills [O03]	N3	Goal 4			
18.4 Demonstrate interpersonal skills [O04]	N4	Goal 2		G1	2
18.5 Demonstrate etiquette and courtesy [O05]	N5	Goal 2			2
18.6 Demonstrate effectiveness in oral and written communication [O06]	N6	Goal 2		G1	2
18.7 Develop and maintain a code of professional ethics [O07]	N7	Goal 4			
18.8 Maintain a good professional appearance [O08]	N8	Goal 4		F5	
18.9 Perform basic tasks related to securing and terminating employment [O09]	N9	Goal 2			
18.10 Perform basic parliamentary procedures in a group meeting [O10]	N10	Goals 2, 4			

ELECTRONICS OCCUPATIONAL SKILLS STANDARDS
(Technical Skills)

Source: *Raising the Standard: Electronics Technician Skills for Today and Tomorrow.* Washington, DC: Electronics Industries Association and Electronic Industries Foundation, 1994.

A. General

A.01 Demonstrate an understanding of proper safety techniques for all types of circuits and components (DC circuits, AC circuits, analog circuits, digital circuits, discrete solid-state circuits, microprocessors)

A.02 Demonstrate an understanding of and comply with relevant OSHA safety standards

A.03 Demonstrate an understanding of proper troubleshooting techniques

A.04 Demonstrate an understanding of basic assembly skills using hand and power tools

A.05 Demonstrate an understanding of acceptable soldering/desoldering techniques, including through-hole and surface mount devices

A.06 Demonstrate an understanding of proper solderless connections

A.07 Demonstrate an understanding of use of data books and cross reference/technical manuals to specify and requisition electronic components

A.08 Demonstrate an understanding of the interpretation and creation of electronic schematics, technical drawings, and flow diagrams

A.09 Demonstrate an understanding of design curves, tables, graphs, and recording of data

A.10 Demonstrate an understanding of color codes and other component descriptors

A.11 Demonstrate an understanding of site electrical and environmental survey

A.12 Demonstrate the use of listening skills or assistive devices to assess signs and symptoms of malfunctions

B. DC Circuits

B.01 Demonstrate an understanding of sources of electricity in DC circuits

B.02 Demonstrate an understanding of principles and operation of batteries

B.03 Demonstrate an understanding of the meaning of and relationships among and between voltage, current, resistance and power in DC

B.04 Demonstrate an understanding of measurement of resistance of conductors and insulators and the computation of conductance

B.05 Demonstrate an understanding of application of Ohms Law to series, parallel and series-parallel circuits

B.06 Demonstrate an understanding of magnetic properties of circuits and devices

B.07 Demonstrate an understanding of the physical, electrical characteristics of capacitors and inductors

B.08 Understand principles and operations of DC series circuits

B.09 Fabricate and demonstrate DC series circuits

B.10 Troubleshoot and repair DC series circuits

B.11 Understand principles and operations of DC parallel circuits

B.12 Fabricate and demonstrate DC parallel circuits

B.13 Troubleshoot and repair DC parallel circuits

B.14 Understand the principles and operations of DC series-parallel and bridge circuits

B.15 Fabricate and demonstrate DC series-parallel and bridge circuits

B.16 Troubleshoot and repair DC series-parallel and bridge circuits

B.17 Understand the principles and operations of the Wheatstone Bridge

B.18 Understand principles and operations of DC voltage divider circuits (loaded and unloaded)

B.19 Fabricate and demonstrate DC voltage divider circuits (loaded and unloaded)

B.20 Troubleshoot and repair DC voltage divider circuits (loaded and unloaded)

B.21 Understand principles and operations of DC RC and RL circuits

B.22 Fabricate and demonstrate DC RC and RL circuits

B.23 Troubleshoot and repair DC RC and RL circuits

B.24 Demonstrate an understanding of measurement of power in DC circuits

C. AC Circuits

C.01 Demonstrate an understanding of sources of electricity in AC circuits

C.02 Demonstrate and understanding of the properties of an AC signal

C.03 Demonstrate an understanding of the principles of operation and characteristics of sinusoidal and non-sinusoidal wave forms

C.04 Demonstrate an understanding of basic motor/generator theory and operation

C.05 Demonstrate an understanding of measurement of power in AC circuits

C.06 Demonstrate an understanding of the principles and operation of various power conditioning: (isolation transformers, surge suppressors, uninterruptable power systems)

C.07 Demonstrate an understanding of the principle and operation of safety grounding systems: (lightning arresters, ground fault interrupters, etc.)

C.08 Understand principles and operations of AC capacitive circuits

C.09 Fabricate and demonstrate AC capacitive circuits

C.10 Troubleshoot and repair AC capacitive circuits

C.11 Understand principles and operations of AC inductive circuits

C.12 Fabricate and demonstrate AC inductive circuits

C.13 Troubleshoot and repair AC inductive circuits

C.14 Understand principles and operations of AC circuits using transformers

C.15 Demonstrate an understanding of impedence matching theory

C.16 Fabricate and demonstrate AC circuits using transformers

C.17 Troubleshoot and repair AC circuits using transformers

C.18 Understand principles and operations of AC differentiator and integrator circuits (determine RC and RL time constants)

C.19 Fabricate and demonstrate AC differentiator and integrator circuits

C.20 Troubleshoot and repair AC differentiator and integrator circuits

C.21 Understand principles and operations of AC series and parallel resonant circuits

C.22 Fabricate and demonstrate AC series and parallel resonant circuits

C.23 Troubleshoot and repair AC series and parallel resonant circuits

C.24 Understand principles and operations of AC RC, RL, and RLC circuits

C.25 Fabricate and demonstrate AC RC, RL, and RLC circuits

C.26 Troubleshoot and repair AC RC, RL, and RLC circuits

C.27 Understand principles and operations of AC frequency selective filter circuits

C.28 Fabricate and demonstrate AC frequency selective filter circuits

C.29 Troubleshoot and repair AC frequency selective filter circuits

C.30 Understand principles and operations of AC polyphase circuits

C.31 Understand principles and operations of AC phase locked loop circuits

C.32 Troubleshoot and repair AC phase locked loop circuits

D. Discrete Solid State Devices

D.01 Demonstrate an understanding of the properties of semiconductor materials

D.02 Demonstrate an understanding of PN junctions

D.03 Demonstrate an understanding of bipolar transistors

D.04 Demonstrate an understanding of field effect transistors (FETs/MOSFETs)

D.05 Demonstrate an understanding of special diodes and transistors

D.06 Understand principles and operations of diode circuits

D.07 Fabricate and demonstrate diode circuits

D.08 Troubleshoot and repair diode circuits

D.09 Understand principles and operations of optoelectronic circuits (gate isolators, interrupt sensor, infra red sensors, etc.)

D.10 Fabricate and demonstrate optoelectronic circuits (gate isolators, interrupt sensors, infra-red sensors, etc.)

D.11 Troubleshoot and repair optoelectronic circuits (gate isolators, interrupt sensors, infra-red sensors, etc.)

D.12 Understand principles and operations of single stage amplifiers

D.13 Fabricate and demonstrate single stage amplifiers

D.14 Troubleshoot and repair single stage amplifiers

D.15 Understand principles and operations of thyristor circuitry (SCR, TRIAC, DIAC, etc.)

D.16 Fabricate and demonstrate thyristor circuitry (SCR, TRIAC, DIAC, ETC.)

D.17 Troubleshoot and repair thyristor circuitry (SCR, TRIAC, DIAC, etc.)

E. Analog Circuits

E.01 Understand principles and operations of multistage amplifiers

E.02 Fabricate and demonstrate multistage amplifiers

E.03 Troubleshoot and repair multistage amplifiers

E.04 Understand principles and operations of IF circuits

E.05 Fabricate and demonstrate IF circuits

E.06 Troubleshoot and repair IF circuits

E.07 Understand principles and operations of linear power supplies and filters

E.08 Fabricate and demonstrate linear power supplies and filters

E.09 Troubleshoot and repair linear power supplies and filters

E.10 Understand principles and operations of operational amplifier circuits

E.11 Fabricate and demonstrate operational amplifier circuits

E.12 Troubleshoot and repair operational amplifier circuits

E.13 Understand principles and operations of audio power amplifiers

E.14 Fabricate and demonstrate audio power amplifiers

E.15 Troubleshoot and repair audio power amplifiers

E.16 Understand principles and operations of regulated and switching power supply circuits

E.17 Troubleshoot and repair regulated and switching power supply circuits

E.18 Understand principles and operations of active filter circuits

E.19 Troubleshoot and repair active filter circuits

E.20 Understand principles and operations of sinusoidal and non-sinusoidal oscillator circuits

E.21 Troubleshoot and repair sinusoidal and non-sinusoidal oscillator circuits

E.22 Understand principles and operations of fiber optic circuits using photodiodes or LASERS

E.23 Troubleshoot and repair fiber optic circuit using photodiodes or LASERS

E.24 Understand principles and operations of RF circuits

E.25 Fabricate and demonstrate RF circuits

E.26 Troubleshoot and repair RF circuits

E.27 Understand principles and operations of signal modulation systems (AM, FM, stereo)

E.28 Troubleshoot and repair signal modulation systems (AM, FM, stereo)

E.29 Demonstrate an understanding of motor phase shift control circuits

E.30 Understand the principles and operations of microwave circuits

F. Digital Circuits

F.01 Demonstrate an understanding of the characteristics of integrated circuits (IC) logic families

F.02 Demonstrate an understanding of minimizing logic circuits using Boolean operations

F.03 Understand principles and operations of linear integrated circuits

F.04 Troubleshoot and repair linear integrated circuits

F.05 Understand principles and operations of types of logic gates

F.06 Fabricate and demonstrate types of logic gates

F.07 Troubleshoot and repair types of logic gates

F.08 Understand principles and operations of combinational logic circuits

F.09 Fabricate and demonstrate combinational logic circuits

F.10 Troubleshoot and repair combinational logic circuits

F.11 Understand principles and operations of types of flip-flop circuits

F.12 Fabricate and demonstrate types of flip-flop circuits

F.13 Troubleshoot and repair flip-flop circuits

F.14 Understand principles and operations of types of registers and counters

F.15 Fabricate and demonstrate types of registers and counters

F.16 Troubleshoot and repair types of registers and counters

F.17 Understand principles and operations of clock and timing circuits

F.18 Fabricate and demonstrate clock and timing circuits

F.19 Troubleshoot and repair clock and timing circuits

F.20 Understand principles and operations of types of arithmetic-logic circuits

F.21 Troubleshoot and repair types of arithmetic-logic circuits

F.22 Understand principles and operations of types of multiplexer and demultiplexer circuits

F.23 Troubleshoot and repair types of multiplexer and demultiplexer circuits

F.24 Understand principles and operations of types of digital to analog and analog to digital circuits

F.25 Troubleshoot and repair types of digital to analog and analog to digital circuits

F.26 Understand principles and operations of types of digital display circuits

F.27 Troubleshoot and repair types of digital display circuits

F.28 Understand principles and operations of power distribution noise problems

F.29 Troubleshoot and repair power distribution noise problems

F.30 Understand principles and operations of types of digital encoders and decoders

F.31 Troubleshoot and repair types of digital encoders and decoders

F.32 Understand principles and operations of digital display devices

F.33 Troubleshoot and repair digital display devices

G. Microprocessors

G.01 Demonstrate an understanding of microprocessor interfaces

G.02 Troubleshoot and repair microprocessor interfaces

G.03 Demonstrate an understanding of essential microprocessor components

G.04 Demonstrate an understanding of microprocessor BUS concepts

G.05 Demonstrate an understanding of microprocessor components and terminology

G.06 Understand principles and operation of types of microprocessor memory circuits

G.07 Troubleshoot and repair types of microprocessor memory circuits

G.08 Understand principles and operations of Microprocessor machine code and instruction sets

H. Microcomputers

H.01 Demonstrate an understanding of microcomputer operating systems

H.02 Demonstrate an understanding of essential microcomputer components

H.03 Demonstrate an understanding of microcomputer peripherals

H.04 Set up and configure a microcomputer using available operating systems and software packages

H.05 Troubleshoot and replace microcomputer peripherals

SHOW-ME STANDARDS

The new educational goals and standards are a result of the Outstanding Schools Act of 1993, which calls on Missouri citizens and educators . . . to define appropriate, rigorous expectations for children's learning. Committees of teachers, citizens, parents, lawmakers and state officials have been working on the proposed goals and standards since then.

To lead productive and fulfilling lives and to continue learning, students in Missouri public schools will acquire the knowledge and skills to:

Goal 1: Gather, analyze and apply information and ideas;

Goal 2: Communicate effectively within and beyond the classroom;

Goal 3: Recognize and solve problems; and

Goal 4: Make decisions and act as responsible members of society

Source: "The Show-Me Standards." Jefferson City, MO: Missouri Department of Elementary and Secondary Education, January 1996.

ALL ASPECTS OF THE INDUSTRY

Recent national legislation requires that vocational education programs provide a strong experience in "all aspects of the industry" (AAOI) for industries that students are preparing to enter. AAOI's ultimate goal is to give future workers a sense of the issues involved in the world of work. Such knowledge can empower future workers to make informed decisions about their career paths. This knowledge can also allow workers to make meaningful contributions to the industry, instead of performing mindlessly like another piece of equipment. The main areas of AAOI include:

- Planning
- Management
- Finance
- Technical and Production Skills
- Principles of Technology
- Labor and Community Issues
- Health/Safety/Environment
- Personal Conduct

Duty Bands and Objectives

A. Planning

- A1 Describe why industries respond to customer wants and expectations.
- A2 List differences in how companies deliver products versus delivering services.
- A3 Describe ways a worker can influence company decision-making.
- A4 Identify benefits in anticipating technology and market trend changes.
- A5 Identify an example of how regulatory laws can impact how a business operates.
- A6 Identify an example of how a political organization can impact how a company operates.

B. Management

- B1 Identify key components of a company "mission statement."
- B2 Identify how a corporate "chain of command" works.
- B3 Describe the significance of a company's "corporate culture."
- B4 Describe how a company organizes its departments.
- B5 List typical ways company departments communicate.
- B6 Cite examples of why a worker should adjust to different management styles.
- B7 Cite an example of how companies are dependent on the national economy.
- B8 Cite an example of how a company is dependent upon the local economy.
- B9 Describe the importance of achieving internal and external customer satisfaction.
- B10 Identify examples of how cultural diversity can affect an industry.
- B11 Identify key differences in how private companies and government agencies operate.
- B12 List reasons why written policies are used in industry.
- B13 Identify resources available from professional organizations.
- B14 Identify how roles and responsibilities in a family business are different than in larger companies.
- B15 List benefits a worker can get by participating in meetings.
- B16 List key differences in how a family farm operates versus how another small business operates.

B17 Describe how a company's marketing affects all its employees.

C. Finance

C1 List typical ways a business obtains capital.
C2 Describe the importance of accounting in a business.
C3 Describe key implications for a company which grants credit.
C4 Describe how a company estimates and bids for a contract.
C5 Describe how paycheck deductions affect a worker.
C6 Describe the importance of cost containment in a company.

D. Technical and Production Skills

D1 Demonstrate a basic math ability.
D2 Demonstrate the capability to measure quickly and accurately.
D3 Demonstrate the ability to speak and write the English language effectively.
D4 Demonstrate the ability to listen effectively.
D5 Demonstrate the ability to use effective negotiation skills.
D6 Demonstrate the ability to manage time effectively.
D7 Demonstrate the ability to read blueprints and drawings.
D8 Demonstrate the ability to perform basic computer operation.
D9 Describe the importance of deadlines and schedules.
D10 Demonstrate the ability to use team player skills.
D11 Demonstrate the ability to use supervisory and delegation skills.
D12 Demonstrate the ability to utilize good public speaking skills.
D13 Describe the importance of using troubleshooting techniques.

D14 Cite one example of a job that is inter-related with another job.
D15 Demonstrate the ability to obtain technical information.
D16 Identify certification requirements for a specific job.

E. Principles of Technology

E1 Describe the key characteristics of the technology used in your industry.
E2 Describe the importance of analyzing new equipment for possible use.
E3 Describe the importance of continuously upgrading one's job skills.
E4 Describe the importance of adaptability and learning from experience.
E5 Describe the importance of acquiring and analyzing information effectively and making sound decisions.
E6 Describe the importance of cross-training.

F. Labor

F1 Describe the importance of a written job description.
F2 Describe the importance of knowing your rights as a worker.
F3 Describe the role labor organizations play in your industry (if any).
F4 List advantages/disadvantages of hourly and salaried pay.
F5 List differences between being a self-employed worker and a worker employed by a company.
F6 Describe the importance of participating in quality enhancement programs.
F7 Describe the importance of understanding why a worker is asked to occasionally work longer hours.
F8 Describe the importance of cultural sensitivity.

G. Community

G1 Describe the importance of recognizing a worker should contribute special skills through volunteer work.

G2 Identify key ways a company helps its community.
G3 Identify key ways a community helps a company.
G4 Identify an impact of buying outside the community.
G5 Describe how a company's public perception is important.
G6 Describe the importance of providing for the access needs of the physically challenged.

H. Health, Safety and Environment

H1 Describe the importance of complying with federal agency regulations.
H2 Describe why it is important to avoid job-specific health threats.
H3 Read and comprehend major components of a Material Safety Data Sheet.
H4 Identify basic safety training (tornado, fire, first aid) techniques.
H5 Describe the importance of participating in preventive medicine programs.
H6 Describe the importance of handling stress effectively.
H7 Describe the importance of good workplace ergonomics.
H8 Identify any effects weather could have on an industry.
H9 Describe the importance of management's responsibility for a safe workplace.

I. Personal Conduct

I1 Describe the importance of recognizing the dignity of all work.
I2 Describe the importance of producing quality and effective work.
I3 Describe the importance of being fit for duty (no drugs, no alcohol).
I4 Describe the importance of exhibiting good attitude, enthusiasm, integrity.
I5 Describe the importance of exhibiting good grooming and appearance.
I6 Describe the importance of good personal financing.

Source: *All Aspects of the Industry (65-9000-I).* University of Missouri-Columbia: Instructional Materials Laboratory, 1994.

PRE-EMPLOYMENT/WORK MATURITY SKILLS

In 1992, three Missouri agencies co-published the *Pre-Employment and Work-Maturity Competencies: A Guide for Practitioners*. The Missouri competencies identified in the practitioner's guide are endorsed by all three agencies: the Missouri Department of Elementary and Secondary Education, the Department of Labor and Industrial Relations, and the Department of Economic Development. The list includes seven core competencies and related employability skills. Locally developed learner outcomes may, of course, be added, and local groups are encouraged to utilize the identified state competencies for development of their own pre-employment and work maturity skills.

A. Making Career Decisions
- A1. Perform self assessment
- A2. Explore occupational information
- A3. Perform decision-making process

B. Using Labor Market Information
- B1. Identify sources of information
- B2. Use labor market information

C. Preparing a Resume
- C1. Collect resume data
- C2. Develop a resume

D. Completing the Job Application Process
- D1. Prepare letters of inquiry
- D2. Provide accurate educational data
- D3. Provide accurate work history data
- D4. Provide accurate personal data
- D5. Provide accurate reference information
- D6. Fill out job application form

E. Demonstrating Effective Interviewing Skills
- E1. Present proper appearance
- E2. Prepare for interview
- E3. Greet the interviewer
- E4. Participate in the interview
- E5. Respond to interview closure
- E6. Prepare a letter of follow-up

F. Demonstrating Knowledge of the Proper Work Attitudes and Behaviors
- F1. Be dependable
- F2. Be punctual
- F3. Maintain a positive attitude and behavior
- F4. Complete tasks effectively with or without supervision
- F5. Practice good grooming and personal hygiene
- F6. Recognize legal issues in the workplace

G. Demonstrating Knowledge of Effective Interpersonal Skills
- G1. Communicate with others
- G2. Maintain relationships with others

SCANS COMPETENCIES

SCANS *foundation skills* identified by the U.S. Department of Labor describe generic skills needed by nearly everyone. The SCANS *competencies*, however, are more specific in nature and are listed below. (SCANS is the acronym for the Secretary [of Labor]'s Commission on Achieving Necessary Skills.) National VICA's *Total Quality Curriculum* incorporates SCANS competencies and Total Quality Management (TQM) principles in a 17-module set of activities.

1. **Resources**
   - Allocates time
   - Allocates money
   - Allocates material and facility resources
   - Allocates human resources

2. **Interpersonal**
   - Participates as a member of a team
   - Teaches others
   - Serves clients/customers
   - Exercises leadership
   - Negotiates to arrive at a decision
   - Works with cultural diversity

3. **Information**
   - Acquires and evaluates information
   - Organizes and maintains information
   - Interprets and communicates information
   - Uses computers to process information

4. **Systems**
   - Understands systems
   - Monitors and corrects performance
   - Improves and designs systems

5. **Technology**
   - Selects technology
   - Applies technology to task
   - Maintains and troubleshoots equipment

Employability Competencies

Personal Characteristics

Directions: Rate the student by checking the appropriate number on each scale. The ratings should be based on your **observation of the student** rather than grades given in class.

Rating Scale: 3 Above Average
2 Average
1 Below Average

3	2	1

Personal Characteristics

1. **Relations with others**
   (effectiveness in working with students, instructors, and others; cooperation; shows respect)
2. **Dependability**
   (attendance, punctuality; adherence to schedules and deadlines; consistency and results; perseverance)
3. **Work attitudes**
   (willingness to learn; willingness to accept and profit from evaluation; enthusiasm; initiative; commitment; pride in work)
4. **Communication**
   (listening, speaking, and nonverbal skills; effectiveness in communicating with students, teachers, and others)
5. **Personal hygiene/grooming**
   (personal health care and cleanliness; dresses and maintains self appropriately)

Others (specify):

_____

_____

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Job Seeking Techniques

Directions: Evaluate the student by checking the appropriate number or letter to indicate the degree of competency. The rating for each task should reflect **employability readiness** rather than the grades given in class.

Rating Scale: 3 Above Average
2 Average
1 Below Average
N No Exposure

3	2	1	N

Job Seeking Techniques

1. Apply information about self and job opportunities in career decision making
2. Write a resume
3. Prepare a job application form
4. Write letters of application and acceptance
5. Arrange for personal references
6. Apply job search techniques
7. Arrange a job interview
8. Apply job interview techniques
9. Evaluate job offers (actual or simulated)

Others (specify):

_____

_____

_____

Entrepreneurship Awareness

Directions: Evaluate the student by checking the appropriate number or letter to indicate the degree of competency. The rating for each task should reflect **employability readiness** rather than the grades given in class.

Rating Scale: 3 Above Average
2 Average
1 Below Average
N No Exposure

3	2	1	N

Entrepreneurship Awareness

1. Describe five characteristics of a free enterprise economic system (ownership of property, profit motive, risk taking, competition, supply and demand)
2. Name four forms of business ownership (sole proprietorship, partnership, corporation, cooperative)
3. Describe advantages and disadvantages of small business ownership
4. Identify steps necessary to start a business (evaluate need, site selection, marketing plan, financial plan, management plan)
5. Identify business opportunities related to training
6. Identify personal traits of the entrepreneur (versatility, aspirations, energy, integrity, adaptability, etc.)

Others (specify):

_____

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_____

Competency Profile

Instructor: _____

Instructional Program: _____

_____

School: _____

School Address: _____

_____

Student: _____

Address: _____

_____

Telephone: _____

Social Security Number: _____

IN CASE OF EMERGENCY, CONTACT

Name: _____

Telephone: _____

Family Doctor: _____

Telephone: _____

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Date of Enrollment: _____ Total Hours Absent: _____

Date of Withdrawal: _____ Total Instructional Hours: _____

Date of Completion: _____ Total On-The-Job Training Hours: _____

On-The-Job Training/Work Experience

Duration of Employment	Job Title	Job Description	Supervisor's Name	Name/Address of Employer	Telephone

The following profile ratings represent the knowledges, skills, and attitudes that this student has demonstated at a given time under given conditions. It does not necessarily represent certification of future abilities.

This project was supported in whole or in part by funds from the Department of Elementary and Secondary Education, Division of Vocational and Adult Education. However, the opinions expressed herein do not necessarily reflect the position or policies of the Missouri Department of Elementary and Secondary Education, Division of Vocational and Adult Education, and no official endorsement should be inferred.

Directions: Evaluate the student by checking the appropriate number or letter to indicate the degree of competency. The rating for each task should reflect **employability readiness** rather than the grades given in class.

Rating Scale: **3 Mastered** - can work independently with no supervision
2 Requires Supervision - can perform job completely with limited supervision
1 Not Mastered - requires instruction and close supervision
N No Exposure - no experience or knowledge in this area

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NOTES: * = Core competencies (essential for the first day on the job). The numbers in brackets (e.g., A01) reflect the IDs used in computerized tracking software.

3	2	1	N	Revised Missouri Competencies	NTMA
				1. Orientation to Machine Shop	
				*1. Operate safely in the workshop in compliance with appropriate OSHA and EPA guidelines [A01]	I-5.2, 6.1
				2. List machine shop safety rules and regulations [A02]	I-5.1, 6.1
				2. Performing Mathematical Calculations	
				*1. Convert common fraction to decimal fraction and vice versa [B01]	KSAO I-2.1
				*2. Determine tap drill size with formula and charts [B02]	I-2.1, 2.8
				*3. Convert customary measurements to metric and vice versa [B03]	
				*4. Use calculator to perform mathematical operations [B04]	
				*5. Verify the accuracy of calculations derived with a calculator [B14]	
				*6. Calculate amount of stock required [B05]	
				7. Calculate part and feature dimensions and locations [B06]	I-2.2, 2.6
				*8. Convert revolutions per minute (rpm) to surface feet per minute (sfpm) [B07]	
				*9. Calculate feeds and speeds [B08]	
				10. Determine tapers for machine set-up per formulas and charts [B09]	
				11. Determine sine bar set-up with formulas and charts [B10]	
				12. Perform angular and simple indexing calculations [B11]	
				*13. Calculate measurements of right triangles [B12]	
				3. Performing Measurement	I-3.1 (mostly KSAOs-related theory)
				*1. Measure using direct-reading instruments (such as scales, protractors and precision levels) [C25]	
				*2. Measure using transfer instruments (such as plain inside and outside calipers, telescoping gages, adjustable hole gages and adjustable parallels) [C26]	
				*3. Measure using precision measuring instruments (such as micrometers, gage blocks, verniers, dial indicators and digital calipers) [C27]	
				4. Measure using surface plate instruments (such as height gages, angle plates, and sine bars and plates) [C28]	
				5. Measure using comparison instruments (such as radius gages, squares, cutter tooth gages and center gages) [C29]	
				6. Measure using other instruments (such as optical comparators, coordinate measuring machines [CMM]) [C30]	
				7. Measure pitch diameters using thread wires [C31]	

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3	2	1	N	Revised Missouri Competencies	NTMA
				Operating Lathes - *Continued*	
				*5. Calculate feeds and speeds for lathe set-up [I05]	I-1.1, II-1.1
				*6. Free-hand grind turning and facing tools [I06]	I-5.3
				*7. Select and apply cutting fluids [I07]	KSAOs
				*8. Operate lathe controls [I08]	I-2.3, 2.4, II-2.3, 2.4, 2.5
				*9. Face workpiece and center drill [I09]	II-2.4
				*10. Set up tooling [I10]	I-2.3, 2.4, II-2.3, 2.4, 2.5, III-2.3, 2.4, 2.5, 2.6
				*11. Turn workpiece between centers [I11]	I-2.3, II-2.3
				*12. Indicate workpiece in four-jaw chuck [I12]	I-2.4
				*13. Drill holes [I13]	
				*14. Ream holes [I14]	
				*15. Bore holes [I15]	II-2.5
				*16. Countersink holes [I16]	
				*17. Counterbore holes [I17]	
				18. Knurl parts [I18]	
				19. Free-hand grind 60-degree threading tool [I19]	
				20. Chase external/internal threads [I36]	
				21. Chase metric threads [I22]	
				22. Cut multiple lead threads [I31]	
				23. Cut Acme threads [I32]	
				24. Use compound rest to cut short external/internal tapered surfaces [I23]	III-2.3
				25. Cut tapers by offset tailstock [I24]	II-2.3
				26. Cut external tapered surface with taper attachment [I25]	II-2.5
				27. Cut internal tapered surface with taper attachment [I26]	II-2.5
				*28. Align workpiece on faceplate [I27]	
				*29. Perform lathe filing [I28]	
				*30. Polish workpiece [I29]	
				31. Turn or thread long workpieces using follower and steady rest [I30]	III-2.4
				32. Use form tooling [I33]	III-2.3
				33. Use mandrel [I34]	
				13. Operating Milling Machines	
				*1. Employ milling machine safety guidelines [J01]	I-6.1
				*2. Perform care and maintenance of milling machines [J02]	I-5.1, 5.2, 5.3
				*3. Tram (align) mill head [J03]	
				[illegible] according to job requirements [J28]	I-2.3, 2.4, 2.5

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				*2. Make a sketch from a finished workpiece [D03]	
				3. Calculate tolerances and allowances [D04]	
				*4. Calculate missing dimensions [D05]	
				5. Use geometric dimensioning and tolerancing [D06]	KSAO I-5.2

3	2	1	N	5. Work Planning	
				*1. Use Machinery's Handbook to plan work [D07]	I-2.1 thru 2.9
				2. Plan sequence of part layout based on blueprint information [D08]	I-1.1, II-1.1
				3. Plan sequence of machining operations [D09]	I-2.3 thru 2.9, II-1.1

3	2	1	N	6. Inspection	
				*1. Inspect part using hand tools (such as scales, micrometers, verniers and protractors) [O01]	I-3.1
				2. Inspect part using surface plate instruments (such as indicators, height gages, angle plates, height-transfer gages, and sine bars and plates) [O02]	I-3.1
				3. Inspect part using optical comparator [O03]	II-3.1
				4. Inspect part using CMM (coordinate measuring machines) [O04]	II-3.2

3	2	1	N	7. Quality Control	
				1. Follow a quality plan [P01]	I-3.2
				2. Participate in capability study [P02]	II-4.1
				3. Analyze the performance of a single-part production process [P03]	I-4.1
				4. Analyze the performance of a production process [P04]	I-4.2

3	2	1	N	8. Performing Layout and Bench Work	
				*1. Use and care for hand tools [E01]	KSAO
				*2. Cut materials with hand hack saw [E02]	I-2.1
				*3. Mark locations with prick and center punches [E04]	I-2.1, II-2.1
				4. Locate holes with transfer screws and transfer punches [E05]	I-2.1, II-2.1
				*5. Bench file/deburr workpiece [E03]	
				6. Cut threads with die [E06]	I-2.1
				7. Cut threads with hand tap [E07]	I-2.1
				8. Ream holes with hand reamer [E08]	I-2.1
				9. True and dress grinding wheels on pedestal/bench grinder [E09]	
				10. Grind and shape tools on pedestal/bench grinder [E10]	
				11. Use abrasives/whetting/polishing/lapping [E11]	III-2.1
				12. Grind using appropriate hand grinder [E12]	
				13. Remove damaged screws [E13]	
				14. Remove broken drills and taps [E14]	
				15. Remove and install dowel pins [E15]	
				16. Install a thread insert [E16]	
				17. Straighten workpiece on arbor press [E17]	
				18. Assemble and disassemble workpiece with arbor press [E18]	
				19. Broach workpiece with broaching tool [E19]	
				20. Assemble and disassemble precision parts [E20]	

3	2	1	N	9. Introduction to Material Science	KSAOs
				*1. Identify types of metals and related materials [F01]	
				2. List properties that affect machinability [F02]	

					II-2.10, 2.11
				*5. Align workpiece mounted on machine table [J05]	
				*6. Calculate feeds and speeds and set up mill accordingly [J06]	I-1.1, II-2.1
				*7. Select and apply cutting fluids [J07]	KSAOs
				*8. Select cutting tool based on job requirements [J08]	I-1.1, II-1.1
				*9. Square up workpiece in milling vise using face mill [J09]	II-2.6
				10. Mill workpiece with end mill [J10]	I-2.6, II-2.6
				11. Locate work with edge finder [J11]	
				12. Drill holes with milling machine [J12]	II-2.7
				*13. Ream holes [J13]	
				*14. Bore holes with milling machine [J14]	II-2.7, 2.12
				15. Use form cutter to mill workpiece [J29]	
				16. Machine workpiece mounted on V-blocks [J16]	
				*17. Machine external straight keyway [J17]	II-2.8
				*18. Machine woodruff keyway [J18]	II-2.8
				*19. Mill simple and compound angles [J30]	III-2.7
				20. Mill an external radius with rotary table [J20]	II-2.10
				21. Mill an internal radius with rotary table [J21]	II-2.10
				*22. Mill workpiece using simple indexing operation [J22]	II-2.11
				*23. Use digital readout [J23]	
				24. Machine workpiece by straddle milling [J24]	
				25. Perform gang milling [J25]	

3	2	1	N	14. Operating Grinders	
				*1. Employ grinder safety guidelines [K01]	I-2.7a, I-6.1
				*2. Perform grinder care and maintenance [K13]	I-5.2
				*3. Select and apply cutting fluids [K03]	KSAOs
				*4. Inspect and ring-test grinding wheel [K14]	I-2.7a
				5. Balance grinding wheel [K05]	II-2.17, III-2.10
				*6. Select and mount grinding wheel [K06]	I-2.7a
				*7. True and dress machine tool grinding wheel [K07]	I-2.7a
				8. Grind workpiece on magnetic chuck using power feed [K08]	I-2.7b, II-2.15
				*9. Square up workpiece on surface grinder [K09]	II-2.15
				*10. Indicate workpiece to be ground [K10]	
				11. Dress form on grinding wheel [K15]	
				12. Grind form into part [K16]	
				13. Grind angular surfaces [K11]	II-2.16
				14. Grind straight and tapered surfaces between centers using cylindrical grinding [K12]	II-2.18, III-2.11

3	2	1	N	15. Tool-and-Cutter Grinding	
				*1. Employ tool-and-cutter grinding safety guidelines [L01]	
				*2. Perform care and maintenance of tool-and-cutter grinder [L02]	
				*3. Inspect and ring-test grinding wheels [L08]	
				4. Select and mount grinding wheel [L04]	
				5. True and dress grinding wheel [L05]	
				6. Set up machine [L06]	
				7. Sharpen cutters on tool-and-cutter grinders [L07]	

3	2	1	N	16. Computerized Numerical Control (CNC) Machines	

				*6. Test workpiece for hardness with and without hardness tester [F06]	
				7. Interpret time-temperature-transformation diagrams [F07]	
				8. Identify the effect of heat treatment on materials [F08]	

3	2	1	N	10. Operating Power Saws	
				*1. Employ power saw safety guidelines [G01]	
				*2. Perform power saw care and maintenance [G02]	
				3. Select blade type for sawing operations and materials [G03]	
				4. Cut and weld band saw blades [G04]	
				*5. Select and set speeds and feeds on power saw [G05]	
				*6. Cut material to length with power saw [G06]	I-2.9
				*7. Select and apply cutting fluids [G08]	KSAOs
				8. Contour saw to scribed line [G09]	II-2.2
				9. Saw internal contours with band saw [G10]	II-2.2

3	2	1	N	11. Operating Drill Presses	
				*1. Employ drill press safety guidelines [H01]	
				*2. Perform drill press care and maintenance [H02]	I-5.1, 5.2, 5.3
				*3. Set up and clamp workpiece to drill press table [H03]	I-2.8
				*4. Select drill type based on job requirements [H04]	I-2.8
				5. Determine cutting tool variables prior to use [H05]	
				*6. Set up drill press according to calculated feeds and speeds [H06]	I-2.8
				*7. Select and apply cutting fluids [H07]	
				*8. Drill holes to specification using manual feed [H08]	I-2.8
				*9. Drill holes to specification using automatic feed [H09]	
				*10. Countersink hole to specifications [H10]	I-2.8
				*11. Counterbore hole to specifications [H11]	I-2.8
				*12. Spotface to specific dimensions [H12]	I-2.8
				*13. Mount workpiece on V-blocks [H13]	
				14. Power ream hole to size [H14]	I-2.8
				15. Use drill jigs and bushings [H15]	
				*16. Hand tap hole using drill press [H16]	
				17. Tap hole with tapping attachments [H17]	I-2.8
				18. Perform taper reaming and subsequent pipe tapping [H20]	II-2.14
				*19. Sharpen drills at a pedestal grinder or with grinding attachments and specialized grinders [H18]	
				20. Set up radial drill press [H19]	II-2.13

3	2	1	N	12. Operating Lathes	
				*1. Employ lathe safety guidelines [I01]	I-6.1
				*2. Perform lathe care and maintenance [I02]	I-5.1, 5.2, 5.3
				*3. Align lathe centers using test bar and dial indicators [I03]	I-2.3, II-2.3
				*4. Select cutting tool based on job requirements [I35]	I-1.1, II-1.1

				3. Calculate coordinates and dimensions needed for CNC program [M03]	
				4. Write program for CNC machine [M04]	II-2.21, III-2.16
				5. Produce RS-274-D program using manufacturing modeling software [M07]	III-2.17
				6. Set up a CNC machine [M05]	III-2.18, 2.19
				7. Machine workpiece with CNC machine [M06]	II-2.22, 2.23, III-2.18, 2.19

3	2	1	N	17. Electric Discharge Machines (EDM)	
				1. Operate a plunge electric discharge machine [Q01]	II-2.19
				2. Operate a two-axis electric discharge machine [Q02]	II-2.20

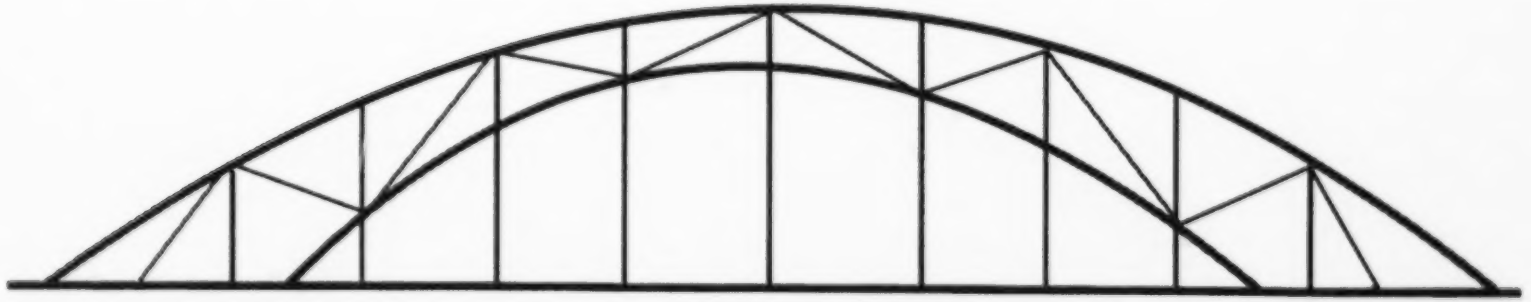
3	2	1	N	18. Leadership Competencies**	
				1. Demonstrate an understanding of VICA, its structure and activities [N01]	
				2. Demonstrate an understanding of one's personal values [N02]	
				3. Perform tasks related to effective personal management skills [N03]	
				4. Demonstrate interpersonal skills [N04]	
				5. Demonstrate etiquette and courtesy [N05]	
				6. Demonstrate effectiveness in oral and written communication [N06]	
				7. Develop and maintain a code of professional ethics [N07]	
				8. Maintain a good professional appearance [N08]	
				9. Perform basic tasks related to securing and terminating employment [N09]	
				10. Perform basic parliamentary procedures in a group meeting [N10]	

**NOTE: These competencies are addressed in the Missouri VICA Curriculum Guide lessons.

3	2	1	N	Areas of Specialization
				1.
				2.
				3.
				4.
				5.
				6.
				7.
				8.
				9.
				10.

Performance Indicators for Machine Tool Technology:

A Bridge to Selected Instructional Materials



• National Skill Standards • Missouri Competencies • Show-Me Standards
• All Aspects of the Industry Objectives • Pre-Employment/Work Maturity Skills
• VICA/SCANS Competencies

Instructional Materials Laboratory
University of Missouri-Columbia

February 1996

INTRODUCTION

This curriculum project includes two parts: an updated Machine Tool Technology competency profile and this performance indicator document. The updated profile contains more information than before. It is cross-referenced to national skill standards (see page 13); core/essential skills are indicated by an asterisk (*); and task IDs for VAMS (Missouri's Vocational Administrative Management System) are shown in brackets.

The Performance Indicator Chart connects technical machine tool technology skills with other important, but more general, skills needed by students. This document also provides instructors and administrators with links between newly updated machine tool technology competencies and (1) previous Mo. competencies, (2) Show-Me Standards for students in Missouri public schools, (3) All Aspects of the Industry objectives, (4) Pre-Employment/Work Maturity Skills, and (5) SCANS competencies (addressed in National VICA's *Total Quality Curriculum).* These sets of skills are listed after the Performance Indicator Chart.

To use the Machine Tool Technology Performance Indicator Chart, consider the following example. Duty bands (umbrella-like categories for competencies) are in **bold** type and shaded.

	Page 19 ↘	Page 20 ↘	Page 23 ↘	Page 24 ↘	
Missouri Competency	**Previous Mo. Competencies**	**Show-Me Standards**	**AAOI Objectives**	**Pre-Employment/ Work Maturity Skills**	**VICA/SCANS Competencies**
2. Performing Mathematical Calculations					
*2 2 Determine tap drill size with formula and charts [B02]	B02	Goal 3	D1	F4	

The second column (Previous Mo. Competencies) is helpful for anyone with curriculum tied to the previous Missouri competency list. As indicated by the chart, competency #2 in Performing Mathematical Calculations (Determine tap drill size with formula and charts) is related to previous competency B02. Performing Mathematical Calculations #2 is also related to the third Show-Me Standard, and so on.

For more detail, obtain or contact the following resources.

- *Duties and Standards for Machining Skills, Level I, II and III.* Fort Washington, MD: National Tooling & Machining Association, 1994.* Contact:
  National Tooling & Machining Association, 9300 Livingston Road, Fort Washington, MD 20744, 800/248-6862, FAX 301/248=7104.
- Machine Tool Technology competency profile (70-6170-C), test-item bank (70-6170-E) and curriculum guide (70-6170-I/S/W). Contact: Instructional Materials Laboratory, 2316 Industrial Drive, Columbia, MO 65211, 800/669-2465, FAX 573/882=1992.
- *Pre-Employment/Work-Maturity Skills Instructional Resource Guide (30-6000-I).* University of Missouri-Columbia: Instructional Materials Laboratory, 1992. Contact:
  IML (see above)

- All Aspects of the Industry (65-9000-I). University of Missouri-Columbia: Instructional Materials Laboratory, 1994. Contact: IML (see above)
- Learning a Living: A Blueprint for High Performance (A SCANS Report for America 2000). Washington, D.C., U.S. Department of Labor, 1992.*
- *Total Quality Curriculum.* Leesburg, VA: National VICA, 1993.* Contact: Education Department, National VICA, PO Box 3000, Leesburg, VA 22075, 800/321-VICA (8422).
- VIMS/VAMS Support Center, 324 Townsend Hall, UMC, Columbia, MO 65211, 573/882-2951, FAX 573/884=5455.

*These resources are available to Missouri educators for free loan from the Missouri Vocational Resource Center (MVRC), University of Missouri-Columbia, 8 London Hall, Columbia, MO 65211 (800/392-7217, FAX 573/882=9935).

ACKNOWLEDGMENTS

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Instructional Materials Laboratory
2316 Industrial Drive, Columbia, MO 65202
800/669-2465 or 573/882-2883

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MACHINE TOOL TECHNOLOGY PERFORMANCE INDICATOR CHART

NOTE: Numbers in brackets represent the IDs used in computerized tracking software in Missouri.
* = Core competencies (essential for the first day on the job)

Missouri Competency	Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	Pre-Employment/ Work Maturity Skills	VICA/SCANS Competencies
1. Orientation to Machine Shop					
*1.1 Operate safely in the workshop in compliance with appropriate OSHA and EPA guidelines [A01]	A1	Goal 4	F3, F5, H1, H3, H9, I1, I3, I4, I5	A1, A2, A3, F3	
1.2 List machine shop safety rules and regulations [A02]	A2 (same)		H2, H4	F5	
2. Performing Mathematical Calculations					
*2.1 Convert common fraction to decimal fraction and vice versa [B01]	B1 (same)	Goal 3	D1	F4	
*2.2 Determine tap drill size with formula and charts [B02]	B2	Goal 3	D1	F4	
*2.3 Convert customary measurements to metric and vice versa [B03]	B3 (same)		D1	F4	
*2.4 Use calculator to perform mathematical operations [B04]	B4 (same)		D1	F4	
*2.5 Verify the accuracy of calculations derived with a calculator [B14]			D1	F4	
*2.6 Calculate amount of stock required [B05]	B5 (same)	Goal 3	D1	F4	3
2.7 Calculate part and feature dimensions and locations [B06]	B6 (same)	Goal 3	D1	F4	3
*2.8 Convert revolutions per minute (rpm) to surface feet per minute (sfpm) [B07]	B7 (same)	Goal 3	D1	F4	3
*2.9 Calculate feeds and speeds [B08]	B8 (same)	Goal 3	D1	F4	3
2.10 Determine tapers for machine set-up per formulas and charts [B09]	B9	Goal 3	D1	F4	3
2.11 Determine sine bar set-up with formulas and charts [B10]	B10	Goal 3	D1	F4	3
2.12 Perform angular and simple indexing calculations [B11]	B11 (same)	Goal 3	D1	F4	3
*2.13 Calculate measurements of right triangles [B12]	B12 (same)	Goal 3	D1	F4	
3. Performing Measurement					
*3.1 Measure using direct-reading instruments (such as scales, protractors and precision levels) [C25]	C2-5, C9-12, C15	Goal 3	D2, D15		5

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Missouri Competency		Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	Pre-Employment/ Work Maturity Skills	VICA/SCANS Competencies
*3.2	Measure using transfer instruments (such as plain inside and outside calipers, telescoping gages, adjustable hole gages and adjustable parallels) [C26]	C6, C8, C13, C15, C18, C20, C21		D1, D2, D15		5
*3.3	Measure using precision measuring instruments (such as micrometers, gage blocks, verniers, dial indicators and digital calipers) [C27]	C9-12, C15		D1, D2, D15		5
3.4	Measure using surface plate instruments (such as height gages, angle plates, and sine bars and plates) [C28]	C15, C17-19, C21		D1, D2, D15		5
3.5	Measure using comparison instruments (such as radius gages, squares, cutter tooth gages and center gages) [C29]	C5		D2, D15		5
3.6	Measure using other instruments (such as optical comparators, coordinate measuring machines [CMM]) [C30]			D2, D8, D15		5
3.7	Measure pitch diameters using thread wires [C31]	C20		D1, D2, D15		5
4. Blueprint Reading						
*4.1	Interpret blueprints, including common drafting symbols [D02]	D1, D2		D7, D15		3
*4.2	Make a sketch from a finished workpiece [D03]	D3 (same)				
4.3	Calculate tolerances and allowances [D04]	D4 (same)	Goal 3			
*4.4	Calculate missing dimensions [D05]	D5 (same)	Goal 3			
4.5	Use geometric dimensioning and tolerancing [D06]	D6 (same)				
5. Work Planning						
*5.1	Use Machinery's Handbook to plan work [D07]	D7 (same)	Goals 1, 3	D15, D16	F4	3
5.2	Plan sequence of part layout based on blueprint information [D08]	D8 (same)	Goal 1	D7	F4	3, 4
5.3	Plan sequence of machining operations [D09]	D9 (same)	Goals 1, 4		F4	3, 4, 5
6. Inspection						
*6.1	Inspect part using hand tools (such as scales, micrometers, verniers and protractors) [O01]		Goals 1, 3	D2	F4	5
6.2	Inspect part using surface plate instruments (such as indicators, height gages, angle plates, height-transfer gages, and sine bars and plates) [O02]		Goals 1, 3	D2	F4	5
6.3	Inspect part using optical comparator [O03]		Goals 1, 3	D2	F4	5

Missouri Competency	Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	Pre-Employment/ Work Maturity Skills	VICA/SCANS Competencies
6.4 Inspect part using CMM (coordinate measuring machines) [O04]		Goals 1, 3	D2	F4	5
7. Quality Control					
7.1 Follow a quality plan [P01]		Goal 4	A4, B9, D16, I2	F4, G1	3, 4
7.2 Participate in capability study [P02]		Goal 4	E5	F4	3, 4
7.3 Analyze the performance of a single-part production process [P03]		Goal 4	E5	F4	3, 4
7.4 Analyze the performance of a production process [P04]		Goal 4	E5	F4	3, 4
8. Performing Layout and Bench Work					
*8.1 Use and care for hand tools [E01]	E1 (same)				5
*8.2 Cut materials with hand hack saw [E02]	E2 (same)				5
*8.3 Mark locations with prick and center punches [E04]	E4 (same)				5
8.4 Locate holes with transfer screws and transfer punches [E05]	E5 (same)		D15		5
*8.5 Bench file/deburr workpiece [E03]	E3 (same)				5
8.6 Cut threads with die [E06]	E6 (same)				5
8.7 Cut threads with hand tap [E07]	E7 (same)				5
8.8 Ream holes with hand reamer [E08]	E8 (same)				5
8.9 True and dress grinding wheels on pedestal/bench grinder [E09]	E9				5
8.10 Grind and shape tools on pedestal/bench grinder [E10]	E10 (same)				5
8.11 Use abrasives/whetting/polishing/lapping [E11]	E11 (same)				5
8.12 Grind using appropriate hand grinder [E12]	E12 (same)				5
8.13 Remove damaged screws [E13]	E13 (same)				5
8.14 Remove broken drills and taps [E14]	E14 (same)				5
8.15 Remove and install dowel pins [E15]	E15 (same)				5
8.16 Install a thread insert [E16]	E16				5
8.17 Straighten workpiece on arbor press [E17]	E17 (same)	Goal 1			5
8.18 Assemble and disassemble workpiece with arbor press [E18]	E18 (same)	Goal 1			5
8.19 Broach workpiece with broaching tool [E19]	E19 (same)				5

Missouri Competency		Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	Pre-Employment/ Work Maturity Skills	VICA/SCANS Competencies
8.20	Assemble and disassemble precision parts [E20]	E20 (same)	Goals 3, 4			5
9. Introduction to Material Science						
*9.1	Identify types of metals and related materials [F01]	F1 (same)	Goals 1, 4	D15	F4	3
9.2	List properties that affect machinability [F02]	F2 (same)	Goals 1, 3	D15, E5	F4	3
9.3	Correlate types of materials to their properties [F03]	F3 (same)	Goals 1, 4	D15	F4	3
9.4	List major cutting tool variables [F04]	F4 (same)		D15	F4	
9.5	Perform heat treatment process [F05]	F5 (same)		D15	F4	
*9.6	Test workpiece for hardness with and without hardness tester [F06]	F6		D15	F4	5
9.7	Interpret time-temperature-transformation diagrams [F07]		Goal 1	D15	F4	3
9.8	Identify the effect of heat treatment on materials [F08]		Goal 1	D15	F4	
10. Operating Power Saws						
*10.1	Employ power saw safety guidelines [G01]	G1		H2, H3	F4	
*10.2	Perform power saw care and maintenance [G02]	G2			F4	
10.3	Select blade type for sawing operations and materials [G03]	G3	Goal 4	D15	F4	
10.4	Cut and weld band saw blades [G04]	G4 (same)			F4	
*10.5	Select and set speeds and feeds on power saw [G05]	G5 (same)	Goal 4	D15	F4	
*10.6	Cut material to length with power saw [G06]	G6		D1, D2	F4	
*10.7	Select and apply cutting fluids [G08]	G8 (same)	Goal 4	D15		
10.8	Contour saw to scribed line [G09]	G9 (same)				
10.9	Saw internal contours with band saw [G10]	G10 (same)				
11. Operating Drill Presses						
*11.1	Employ drill press safety guidelines [H01]	H1	Goal 4	H2	F4	
*11.2	Perform drill press care and maintenance [H02]	H2			F4	
*11.3	Set up and clamp workpiece to drill press table [H03]	H3 (same)			F4	
*11.4	Select drill type based on job requirements [H04]	H4	Goal 4		F4	
11.5	Determine cutting tool variables prior to use [H05]	H5 (same)	Goal 4	D15	F4	

Missouri Competency	Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	Pre-Employment/ Work Maturity Skills	VICA/SCANS Competencies
*11.6 Set up drill press according to calculated feeds and speeds [H06]	H6 (same)			F4	
*11.7 Select and apply cutting fluids [H07]	H7 (same)	Goal 4		F4	
*11.8 Drill holes to specification using manual feed [H08]	H8 (same)	Goal 1		F4	
*11.9 Drill holes to specification using automatic feed [H09]	H9 (same)	Goal 1		F4	
*11.10 Countersink hole to specifications [H10]	H10 (same)	Goal 1		F4	
*11.11 Counterbore hole to specifications [H11]	H11 (same)	Goal 1		F4	
*11.12 Spotface to specific dimensions [H12]	H12 (same)	Goal 1		F4	
*11.13 Mount workpiece on V-blocks [H13]	H13 (same)			F4	
11.14 Power ream hole to size [H14]	H14 (same)			F4	
11.15 Use drill jigs and bushings [H15]	H15 (same)			F4	
*11.16 Hand tap hole using drill press [H16]	H16 (same)			F4	
11.17 Tap hole with tapping attachments [H17]	H17 (same)			F4	
11.18 Perform taper reaming and subsequent pipe tapping [H20]				F4	
*11.19 Sharpen drills at a pedestal grinder or with grinding attachments and specialized grinders [H18]	H18			F4	
11.20 Set up radial drill press [H19]	H19 (same)			F4	
12. Operating Lathes					
*12.1 Employ lathe safety guidelines [I01]	I1	Goals 1, 4	H2, H3		3
*12.2 Perform lathe care and maintenance [I02]	I2 (same)	Goal 1	D13, D15		5
*12.3 Align lathe centers using test bar and dial indicators [I03]	I3 (same)	Goal 1			5
*12.4 Select cutting tool based on job requirements [I35]	I4	Goal 1	D7, D15		3, 5
*12.5 Calculate feeds and speeds for lathe set-up [I05]	I5 (same)	Goals 1, 3	D1, D15		3
*12.6 Free-hand grind turning and facing tools [I06]	I6 (same)	Goal 1			5
*12.7 Select and apply cutting fluids [I07]	I7 (same)	Goal 1	D15		3, 5
*12.8 Operate lathe controls [I08]	I8 (same)	Goal 1			3, 5
*12.9 Face workpiece and center drill [I09]	I9 (same)	Goal 1			3, 5
*12.10 Set up tooling [I10]	I10 (same)	Goals 1, 3			5

Missouri Competency	Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	Pre-Employment/ Work Maturity Skills	VICA/SCANS Competencies
*12.11 Turn workpiece between centers [I11]	I11 (same)	Goal 1			5
*12.12 Indicate workpiece in four-jaw chuck [I12]	I12	Goal 1			5
*12.13 Drill holes [I13]	I13 (same)	Goal 1			5
*12.14 Ream holes [I14]	I14 (same)	Goal 1			5
*12.15 Bore holes [I15]	I15 (same)	Goal 1			5
*12.16 Countersink holes [I16]	I16 (same)	Goal 1			5
*12.17 Counterbore holes [I17]	I17 (same)	Goal 1			5
12.18 Knurl parts [I18]	I18 (same)	Goal 1			5
12.19 Free-hand grind 60-degree threading tool [I19]	I19 (same)	Goal 1			5
12.20 Chase external/internal threads [I36]	I20, I21	Goal 1			5
12.21 Chase metric threads [I22]	I22 (same)	Goal 1			5
12.22 Cut multiple lead threads [I31]	I31	Goal 1			5
12.23 Cut Acme threads [I32]	I32 (same)	Goal 1			5
12.24 Use compound rest to cut short external/internal tapered surfaces [I23]	I23	Goal 1			5
12.25 Cut tapers by offset tailstock [I24]	I24 (same)	Goal 1			5
12.26 Cut external tapered surface with taper attachment [I25]	I25	Goal 1			5
12.27 Cut internal tapered surface with taper attachment [I26]	I26 (same)	Goal 1			5
*12.28 Align workpiece on faceplate [I27]	I27 (same)	Goal 1			5
*12.29 Perform lathe filing [I28]	I28 (same)	Goal 1			5
*12.30 Polish workpiece [I29]	I29 (same)	Goal 1			5
12.31 Turn or thread long workpieces using follower and steady rest [I30]	I30 (same)	Goal 1			5
12.32 Use form tooling [I33]	I33 (same)	Goal 1			5
12.33 Use mandrel [I34]	I34 (same)	Goal 1			5
13. Operating Milling Machines					
*13.1 Employ milling machine safety guidelines [J01]	J1	Goal 4	H2, H3	F4	
*13.2 Perform care and maintenance of milling machines [J02]	J2			F4	

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Missouri Competency	Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	Pre-Employment/ Work Maturity Skills	VICA/SCANS Competencies
*13.3 Tram (align) mill head [J03]	J3			F4	
*13.4 Select milling machine attachments according to job requirements [J28]		Goals 3, 4		F4	
*13.5 Align workpiece mounted on machine table [J05]	J5 (same)			F4	
*13.6 Calculate feeds and speeds and set up mill accordingly [J06]	J6	Goal 4	D1	F4	3, 5
*13.7 Select and apply cutting fluids [J07]	J7		D15	F4	
*13.8 Select cutting tool based on job requirements [J08]	J8	Goal 4		F4	
*13.9 Square up workpiece in milling vise using face mill [J09]	J9			F4	
13.10 Mill workpiece with end mill [J10]	J10 (same)			F4	
13.11 Locate work with edge finder [J11]	J11 (same)			F4	
13.12 Drill holes with milling machine [J12]	J12 (same)			F4	
*13.13 Ream holes [J13]	J13 (same)			F4	
*13.14 Bore holes with milling machine [J14]	J14 (same)			F4	
13.15 Use form cutter to mill workpiece [J29]	J15			F4	
13.16 Machine workpiece mounted on V-blocks [J16]	J16 (same)			F4	
*13.17 Machine external straight keyway [J17]	J17 (same)			F4	
*13.18 Machine woodruff keyway [J18]	J18 (same)			F4	
*13.19 Mill simple and compound angles [J30]	J19			F4	
13.20 Mill an external radius with rotary table [J20]	J20 (same)		D1, E4	F4	
13.21 Mill an internal radius with rotary table [J21]	J21 (same)		D1, E4	F4	
*13.22 Mill workpiece using simple indexing operation [J22]	J22 (same)		D1, E4	F4	
*13.23 Use digital readout [J23]	J23 (same)		D1	F4	
13.24 Machine workpiece by straddle milling [J24]	J24 (same)			F4	
13.25 Perform gang milling [J25]	J25 (same)			F4	
14. Operating Grinders					
*14.1 Employ grinder safety guidelines [K01]	K1	Goals 1, 4	H2, H3		3
*14.2 Perform grinder care and maintenance [K13]	K2	Goal 1			5

Missouri Competency	Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	Pre-Employment/ Work Maturity Skills	VICA/SCANS Competencies
*14.3 Select and apply cutting fluids [K03]	K3 (same)	Goals 1, 3, 4	D15		3, 5
*14.4 Inspect and ring-test grinding wheel [K14]	K4				5
14.5 Balance grinding wheel [K05]	K5 (same)				5
*14.6 Select and mount grinding wheel [K06]	K6 (same)				3, 5
*14.7 True and dress machine tool grinding wheel [K07]	K7				5
14.8 Grind workpiece on magnetic chuck using power feed [K08]	K8 (same)				5
*14.9 Square up workpiece on surface grinder [K09]	K9	Goals 1, 3			5
*14.10 Indicate workpiece to be ground [K10]	K10 (same)	Goals 1, 3			5
14.11 Dress form on grinding wheel [K15]		Goals 1, 3			5
14.12 Grind form into part [K16]		Goals 1, 3			5
14.13 Grind angular surfaces [K11]	K11 (same)	Goals 1, 3			5
14.14 Grind straight and tapered surfaces between centers using cylindrical grinding [K12]	K12	Goals 1, 3			5
15. Tool-and-Cutter Grinding					
*15.1 Employ tool-and-cutter grinding safety guidelines [L01]	L1	Goal 4	H2, H3	F4	
*15.2 Perform care and maintenance of tool-and-cutter grinder [L02]	L2			F4	
*15.3 Inspect and ring-test grinding wheels [L08]	L3			F4	
15.4 Select and mount grinding wheel [L04]	L4 (same)			F4	
15.5 True and dress grinding wheel [L05]	L5			F4	
15.6 Set up machine [L06]	L6 (same)			F4	
15.7 Sharpen cutters on tool-and-cutter grinders [L07]	L7 (same)			F4	
16. Computerized Numerical Control (CNC) Machines					
*16.1 Employ CNC machine safety guidelines [M01]	M1	Goal 1	H2, H3		3
*16.2 Perform care and maintenance [M02]	M2 (same)	Goal 1			3
16.3 Calculate coordinates and dimensions needed for CNC program [M03]	M3	Goals 1, 3	D1, D7		3, 5
16.4 Write program for CNC machine [M04]	M4 (same)	Goals 1, 3			3

Missouri Competency	Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	Pre-Employment/ Work Maturity Skills	VICA/SCANS Competencies
16.5 Produce RS-274-D program using manufacturing modeling software [M07]		Goals 1, 3	D8		3
16.6 Set up a CNC machine [M05]	M5 (same)	Goals 1, 3			5
16.7 Machine workpiece with CNC machine [M06]	M6 (same)	Goals 1, 3			5
17. Electric Discharge Machines (EDM)					
17.1 Operate a plunge (ram-type) electric discharge machine [Q01]		Goals 1, 3			5
17.2 Operate a wire electric discharge machine [Q02]		Goals 1, 3			5
18. Leadership Competencies					
18.1 Demonstrate an understanding of VICA, its structure and activities [N01]	N1	Goal 1			4
18.2 Demonstrate an understanding of one's personal values [N02]	N2	Goal 1			
18.3 Perform tasks related to effective personal management skills [N03]	N3	Goal 4	I4		
18.4 Demonstrate interpersonal skills [N04]	N4	Goal 2	I4	G1	2
18.5 Demonstrate etiquette and courtesy [N05]	N5	Goal 2	I4		2
18.6 Demonstrate effectiveness in oral and written communication [N06]	N6	Goal 2		G1	2
18.7 Develop and maintain a code of professional ethics [N07]	N7	Goal 4			
18.8 Maintain a good professional appearance [N08]	N8	Goal 4	I5	F5	
18.9 Perform basic tasks related to securing and terminating employment [N09]	N9	Goals 2, 4			
18.10 Perform basic parliamentary procedures in a group meeting [N10]	N10	Goals 2, 4			2, 4

METALWORKING OCCUPATIONAL SKILLS STANDARDS

Machining Skills I

Source: *Duties and Standards for Machining Skills, Level I, II and III.* Fort Washington, MD: National Tooling & Machining Association, 1994.

KSAO = Knowledge, Skills, Abilities or Other Characteristics. These characteristics detail the knowledge, academic skills and other necessary, supportive characteristics for metalworking standards and are described more fully in the Machining Skills I standards. KSAOs include written and oral communication, math, decision-making and problem-solving skills, group skills and personal qualities, engineering drawings and sketches, measurement and metalworking theory.

Most of the Machining I skills can be met in 6-12 months of education and training. An individual with Level I Machining Skills is a skilled machine operator or technician who has demonstrated competence in the three general areas of responsibility (Bench Skills, Metal Cutting Skills, Inspection and Quality Assurance Skills). No direct supervision or training responsibilities of other operators or other production workers are assumed at level I. Note: headings in bold print represent the broad duty areas.

1. Job Planning and Management

1.1 *Job Process Planning*
Develop a process plan for a part requiring milling, drilling, turning or grinding. Fill out an operation sheet detailing the process plan and required speeds and feeds.

2. Job Execution

2.1 *Manual Operations: Benchwork*
Tap holes. Use files, scrapers and coated abrasives to deburr parts. Use arbor presses to perform press fits. Use bench vises and hand tools appropriately.

2.2 *Manual Operations: Layout*
Lay out the location of hole centers and surfaces within an accuracy of ±.015.

2.3 *Turning Operations: Between Centers Turning*
Set up and carry out between centers turning operations for straight turning.

2.4 *Turning Operations: Chucking*
Set up and carry out chucking operations for turning.

2.5 *Power Feed Milling*
Set up and operate a horizontal or vertical milling machine using power feeds. Perform routine milling.

2.6 *Vertical Milling*
Setup and operate vertical milling machines. Perform routine milling and location of hole centers within ±.005".

2.7a *Surface Grinding, Grinding Wheel Safety*
Ring test grinding wheels, perform visual safety inspection, mount and dress a grinding wheel in preparation for surface grinding.

2.7b *Surface Grinding, Horizontal Spindle, Reciprocating Table*
Set up and operate manual surface grinders with a 10" and smaller diameter wheel. Perform routine surface grinding,

location of surfacesand squaring of surfaces. Perform wheel dressing.

2.8 *Drill Press*
Set up and operate drill presses. Perform routine drill press operations.

2.9 *Power Saw Operation*
Set up and operate power saws for cutoff operations.

3. Quality Control and Inspection

3.1 *Part Inspection*
Develop an inspection plan and inspect simple parts using precision tools and techniques. Prepare reports on the compliance of the parts.

3.2 *Process Control*
Follow a sampling plan. Inspect the samples for the required data. Enter the data on appropriate charts. Graph the data. Respond to the warning conditions indicated by the process charts.

4. Process Adjustment and Improvement

4.1 *Process Adjustment-Single Part Production*
Analyze the performance of a single-part production process. Formulate process adjustments or improvements where appropriate. Where appropriate, notify supervision of the proposed adjustment and/or improvement. Where authorized, carry out the strategies for process adjustment and/or improvement.

4.2 *Participation in Process Improvement*
As a member of a process team, analyze the performance of a production process. With the team, formulate process adjustments or improvements where appropriate. Where appropriate, notify supervision of the proposed adjustments and/or improvement. Where authorized, carry out the strategies for process adjustment and/or improvement.

5. General Maintenance

5.1 *General Housekeeping and Maintenance*
Keep the duty station clean and safe for work. Keep the tools, workbenches and manual equipment clean, maintained and safe for work.

5.2 *Preventive Maintenance, Machine Tools*
Inspect and assess the general condition of an assigned machine tool. Make routine adjustments as necessary and as authorized. Report problems to supervision which are beyond the scope of authority. Carry out daily, weekly and/or monthly routine upkeep chores cited on checklists for a given machine tool.

5.3 *Tooling Maintenance*
Inspect and assess the condition of tooling. Refurbish tooling where appropriate. Refer tooling for repair or regrind where appropriate.

6. Industrial Safety and Environmental Protection

6.1 *Machine Operations and Material Handling*
Carry out assigned responsibilities while adhering to safe practices in accordance with OSHA requirements and guidelines. Document safety activities as required.

6.2 *Hazardous Materials Handling and Storage*
Handle and store hazardous materials as assigned while adhering to safe practices in accordance with OSHA and EPA requirements and guidelines. Document safety activities as required.

7. Career Management and Employment Relations

7.1 *Career Planning*
Develop and explain a short-term career plan and resume.

7.2 *Job Application and Interviewing*
Complete job application form and demonstrate interviewing skills.

7.3 *Teamwork and Interpersonal Relations*
Demonstrate appropriate interpersonal skills in job performance evaluations, group communication and decision-making, and conflict resolution.

7.4 *Organizational Structures and Work Relations*
Identify and explain the major departments or functions in a metalworking company and how they affect production units.

7.5 *Employment Relations*
Understand and explain employment rights and responsibilities in metalworking companies.

Machining Skills II

Used by skilled tradespersons who have achieved proficiency in the core competencies of Machining Skills I and advanced to higher levels of technical competency or have developed new competencies in the three general areas of responsibility. No direct supervision or training responsibilities for other operators or production workers are assumed at level II. However, people who have achieved Machine Skills II competence will occasionally provide training for beginning machining technicians.

1. Job Planning and Management

1.1 *Job Process Planning*
Write a detailed process plan that includes a quality plan for a part requiring milling, drilling, turning or grinding. Produce an operation sheet detailing the process plan and required speeds and feeds. Provide sketches as needed.

2. Job Execution

2.1 *Lay Out Bolt Circles, Angles, Points of Tangency and Profiles of a Line*
Set up and lay out bolt circles, locations of surfaces related by non-right angles, locations of points of tangency between arcs and lines, and profiles of a line which is non-arc based.

2.2 *Contour Bandsawing*
Set up and perform contour sawing to a layout. Choose and mount appropriate blades. Weld, break and reweld blades as necessary.

2.3 *Turning Operations: Between Centers Taper Turning*
Set up and perform between centers turning for straight and tapered turning by offsetting the tailstock.

2.4 *Production: Turning*
Set up and operate a turning machine to produce a collection of parts.

2.5 *Turning Operations: Chucking, O.D. and I.D. Tapers Using a Taper Attachment*
Set up and perform tapered boring and turning using a taper attachment.

2.6 *Milling: Square Up a Block*
Set up and perform squaring up the six surfaces of a block to within ±.002 and .002 over 4" squareness.

2.7 *Vertical Mill: Precision Location of Holes*
Set up and perform boring for location, size and finish.

2.8 *Milling: Cut a Keyseat*
Set up and perform milling keyseats on a shaft.

2.9 *Milling: Cut a Deep Slot with a Staggertooth Cutter*
Set up and perform the cutting of a deep slot using a staggertooth cutter.

2.10 *Milling: Use Rotary Tables*
Set up and perform the development of surfaces at a specified non-right angle using a rotary table. Set up and establish hole locations in various relationships to one another using a rotary table. The holes are in the same plane. Establish the profile of a radius with respect to two surfaces and the connecting points of tangency.

2.11 *Milling: Dividing Head Operations*
Set up and perform operations requiring a dividing head. Set up and establish hole locations in various relationships to one another using a dividing head. Establish the profile of a radius with respect to two surfaces and the connecting points of tangency.

2.12 *Basic Horizontal Boring Mill Operations*
Set up and perform boring for location, size and finish, and mill a slot for location and size.

2.13 *Drilling: Radial Drill*
Set up and perform drilling operations using a radial drill.

2.14 *Machine Tool Power Tapping: Taper Reaming and Pipe Tapping*
Set up and perform taper reaming and subsequent pipe tapping.

2.15 *Surface Grinding: Finish Flats to ±.0005*
Grind a block's six faces to finished dimensions having tolerances of ±.0005 and squareness of .0005 over 4" and 32 microinch surface finish. Dress the wheel as necessary.

2.16 *Surface Grinding: Finish Flats at Simple Angles*
Set up and perform the finish surface grinding of flat surfaces at simple angles with respect to one another. Dress the wheel as necessary.

2.17 *Grinding Wheel Preparation and Balancing*
Set up and perform the preparation and balancing of a grinding wheel 14" diameter or greater. Place the wheel into service.

2.18 *Cylindrical Grinding*
Set up and perform between centers grinding for straight diameters. Dress the grinding wheel as necessary.

2.19 *EDM: Operate a Plunge EDM*
Operate a plunge electric discharge machine.

2.20 *EDM: Operate a 2 Axis Wire EDM*
Operate a 2 axis wire electric discharge machine.

2.21 *CNC: Write Simple RS274-D Program*
Using a computer and editor software, write simple RS274-D programs. Simple programs are single plane, cutter centerline, linear and circular interpolation, single cutter, with no canned cycles.

2.22 *CNC: Operate a CNC Mill*
Operate a CNC milling machine.

2.23 *CNC: Operate a CNC Lathe*
Operate a CNC lathe.

3. Quality Control and Inspection

3.1 *Inspection: Optical Comparator*
Set up and perform the inspection of profiles in shadow and in reflection.

3.2 *Inspection: Manual Coordinate Measuring Machine*
Set up and perform the inspection of parts.

4. Process Adjustment and Control

4.1 *Participate in Capability Studies*
Participate as a team member in a capability study. Perform the required statistical calculations to support the capability study. With the assistance of the team leader, prepare the necessary shop reports for the capability study.

Machining Skills III

Used by skilled tradespersons who have achieved proficiency in the core competencies of Machining Skills I and II and advanced to higher levels of technical competency or have developed new competencies. A person who has achieved Machining Skills III competency may have modest supervision responsibilities for other operators or production workers and will be called upon to provide training for machining technicians.

2. Job Execution

2.1 *Bench Operations: Hand Lapping*
Hand lap small surfaces to finish.

2.2 *Angle Contour Bandsawing*
Set up and perform contour sawing to a layout which requires the part to be sawed at angles with respect to the top and/or bottom. Choose and mount appropriate blades. Weld, break and reweld blades as necessary.

2.3 *Turning Operations: Manual Contour Turning*
Set up and perform contour turning using tapers and form tools as necessary.

2.4 *Turning Operations: Steady Rest Turning and Boring*
Set up and perform turning and boring operations requiring a steady rest.

2.5 *Turning Operations: Follower Rest Turning*
Set up and perform turning operations benefitting from the use of a follower rest.

2.6 *Turning Operations: Difficult Materials*
Set up and perform turning refractory materials.

2.7 *Milling: Mill Compound Angles*
Set up and mill flat surfaces at compound angles with respect to each other.

2.8 *Milling: Manual Contour Milling*
Set up and mill curved surfaces through linear moves of varying lengths using methods of approximation from tapers, radii, interpolationand sectioned templates.

2.9 *Horizontal Boring Mill: Line Boring*
Set up and bore a series of in-line concentric bores using line-boring techniques and the boring mill footstock.

2.10a *Grinding: Select, Inspect, Set Up and Balance Wheels*
Prepare grinding wheels for mounting in a cylindrical grinder or surface grinder. Mount the wheel and grind a 16 microinch finish on a surface. Dress as necessary.

2.10b *Grinding: Tapered Cylindrical Grinding*
Set up and grind tapers on a cylindrical grinder.

2.11 *Grinding: Grind I.D. and O.D. Surfaces*
Set up and grind I.D. and O.D. surfaces on a universal grinding machine or O.D./I.D. grinder.

2.12 *Grinding: Grind Tapers on a Universal Grinder*
Set up and grind tapers on a universal grinder.

2.13 *Grinding: Contour Grinding*
Set up and grind curved and irregular surfaces by using linear incremental moves, tapers, radii, interpolation and approximation with the aid of a visual comparator and a radius dresser.

2.14 *EDM: Operate a 4 Axis Wire EDM*
Operate a 4 axis wire electric discharge machine.

2.15 *CNC: Advanced Manual RS-274-D Programming*
Using a computer and editor write sophisticated RS-274-D programs. Sophisticated programs will contain various combinations of change of place, canned cycles, will employ multiple tools, cutter offsets, linear, circular and helical interpolation as well as requiring the matching of surfaces along lines and points of tangency in 3 axes. Store the results on computer media.

2.16 *CNC: Use Manufacturing Modeling Software to Create RS-274-D Programs*
Create RS-274-D programs using a manufacturing modeling software package.

2.17 *CNC: Milling Centers*
Set up and operate a CNC milling center.

2.18 *CNC: Turning Centers*
Set up and operate turning centers.

2.19 *CNC: Turning Centers with Secondary Milling*
Set up and operate turning centers with secondary milling operations.

SHOW-ME STANDARDS

The new educational goals and standards are a result of the Outstanding Schools Act of 1993, which calls on Missouri citizens and educators . . . to define appropriate, rigorous expectations for children's learning. Committees of teachers, citizens, parents, lawmakers and state officials have been working on the proposed goals and standards since then.

To lead productive and fulfilling lives and to continue learning, students in Missouri public schools will acquire the knowledge and skills to:

Goal 1: Gather, analyze and apply information and ideas;

Goal 2: Communicate effectively within and beyond the classroom;

Goal 3: Recognize and solve problems; and

Goal 4: Make decisions and act as responsible members of society

Source: "The Show-Me Standards." Jefferson City, MO: Missouri Department of Elementary and Secondary Education, January 1996.

ALL ASPECTS OF THE INDUSTRY

Recent national legislation requires that vocational education programs provide a strong experience in "all aspects of the industry" (AAOI) for industries that students are preparing to enter. AAOI's ultimate goal is to give future workers a sense of the issues involved in the world of work. Such knowledge can empower future workers to make informed decisions about their career paths. This knowledge can also allow workers to make meaningful contributions to the industry, instead of performing mindlessly like another piece of equipment. The main areas of AAOI include:

- Planning
- Management
- Finance
- Technical and Production Skills
- Principles of Technology
- Labor and Community Issues
- Health/Safety/Environment
- Personal Conduct

Duty Bands and Objectives

A. Planning

- A1 Describe why industries respond to customer wants and expectations.
- A2 List differences in how companies deliver products versus delivering services.
- A3 Describe ways a worker can influence company decision-making.
- A4 Identify benefits in anticipating technology and market trend changes.
- A5 Identify an example of how regulatory laws can impact how a business operates.
- A6 Identify an example of how a political organization can impact how a company operates.

B. Management

- B1 Identify key components of a company "mission statement."
- B2 Identify how a corporate "chain of command" works.
- B3 Describe the significance of a company's "corporate culture."
- B4 Describe how a company organizes its departments.
- B5 List typical ways company departments communicate.
- B6 Cite examples of why a worker should adjust to different management styles.
- B7 Cite an example of how companies are dependent on the national economy.
- B8 Cite an example of how a company is dependent upon the local economy.
- B9 Describe the importance of achieving internal and external customer satisfaction.
- B10 Identify examples of how cultural diversity can affect an industry.
- B11 Identify key differences in how private companies and government agencies operate.
- B12 List reasons why written policies are used in industry.
- B13 Identify resources available from professional organizations.
- B14 Identify how roles and responsibilities in a family business are different than in larger companies.
- B15 List benefits a worker can get by participating in meetings.
- B16 List key differences in how a family farm operates versus how another small business operates.

B17 Describe how a company's marketing affects all its employees.

C. Finance

C1 List typical ways a business obtains capital.
C2 Describe the importance of accounting in a business.
C3 Describe key implications for a company which grants credit.
C4 Describe how a company estimates and bids for a contract.
C5 Describe how paycheck deductions affect a worker.
C6 Describe the importance of cost containment in a company.

D. Technical and Production Skills

D1 Demonstrate a basic math ability.
D2 Demonstrate the capability to measure quickly and accurately.
D3 Demonstrate the ability to speak and write the English language effectively.
D4 Demonstrate the ability to listen effectively.
D5 Demonstrate the ability to use effective negotiation skills.
D6 Demonstrate the ability to manage time effectively.
D7 Demonstrate the ability to read blueprints and drawings.
D8 Demonstrate the ability to perform basic computer operation.
D9 Describe the importance of deadlines and schedules.
D10 Demonstrate the ability to use team player skills.
D11 Demonstrate the ability to use supervisory and delegation skills.
D12 Demonstrate the ability to utilize good public speaking skills.
D13 Describe the importance of using troubleshooting techniques.

D14 Cite one example of a job that is inter-related with another job.
D15 Demonstrate the ability to obtain technical information.
D16 Identify certification requirements for a specific job.

E. Principles of Technology

E1 Describe the key characteristics of the technology used in your industry.
E2 Describe the importance of analyzing new equipment for possible use.
E3 Describe the importance of continuously upgrading one's job skills.
E4 Describe the importance of adaptability and learning from experience.
E5 Describe the importance of acquiring and analyzing information effectively and making sound decisions.
E6 Describe the importance of cross-training.

F. Labor

F1 Describe the importance of a written job description.
F2 Describe the importance of knowing your rights as a worker.
F3 Describe the role labor organizations play in your industry (if any).
F4 List advantages/disadvantages of hourly and salaried pay.
F5 List differences between being a self-employed worker and a worker employed by a company.
F6 Describe the importance of participating in quality enhancement programs.
F7 Describe the importance of understanding why a worker is asked to occasionally work longer hours.
F8 Describe the importance of cultural sensitivity.

G. Community

G1 Describe the importance of recognizing a worker should contribute special skills through volunteer work.

G2 Identify key ways a company helps its community.
G3 Identify key ways a community helps a company.
G4 Identify an impact of buying outside the community.
G5 Describe how a company's public perception is important.
G6 Describe the importance of providing for the access needs of the physically challenged.

H. Health, Safety and Environment

H1 Describe the importance of complying with federal agency regulations.
H2 Describe why it is important to avoid job-specific health threats.
H3 Read and comprehend major components of a Material Safety Data Sheet.
H4 Identify basic safety training (tornado, fire, first aid) techniques.
H5 Describe the importance of participating in preventive medicine programs.
H6 Describe the importance of handling stress effectively.
H7 Describe the importance of good workplace ergonomics.
H8 Identify any effects weather could have on an industry.
H9 Describe the importance of management's responsibility for a safe workplace.

I. Personal Conduct

I1 Describe the importance of recognizing the dignity of all work.
I2 Describe the importance of producing quality and effective work.
I3 Describe the importance of being fit for duty (no drugs, no alcohol).
I4 Describe the importance of exhibiting good attitude, enthusiasm, integrity.
I5 Describe the importance of exhibiting good grooming and appearance.
I6 Describe the importance of good personal financing.

Source: *All Aspects of the Industry (65-9000-I).* University of Missouri-Columbia: Instructional Materials Laboratory, 1994.

PRE-EMPLOYMENT/WORK MATURITY SKILLS

In 1992, three Missouri agencies co-published the *Pre-Employment and Work-Maturity Competencies: A Guide for Practitioners.* The Missouri competencies identified in the practitioner's guide are endorsed by all three agencies: the Missouri Department of Elementary and Secondary Education, the Department of Labor and Industrial Relations and the Department of Economic Development. The list includes seven core competencies and related employability skills. Locally developed learner outcomes may, of course, be added, and local groups are encouraged to utilize the identified state competencies for development of their own pre-employment and work maturity skills.

A. Making Career Decisions
- A1. Perform self assessment
- A2. Explore occupational information
- A3. Perform decision-making process

B. Using Labor Market Information
- B1. Identify sources of information
- B2. Use labor market information

C. Preparing a Resume
- C1. Collect resume data
- C2. Develop a resume

D. Completing the Job Application Process
- D1. Prepare letters of inquiry
- D2. Provide accurate educational data
- D3. Provide accurate work history data
- D4. Provide accurate personal data
- D5. Provide accurate reference information
- D6. Fill out job application form

E. Demonstrating Effective Interviewing Skills
- E1. Present proper appearance
- E2. Prepare for interview
- E3. Greet the interviewer
- E4. Participate in the interview
- E5. Respond to interview closure
- E6. Prepare a letter of follow-up

F. Demonstrating Knowledge of the Proper Work Attitudes and Behaviors
- F1. Be dependable
- F2. Be punctual
- F3. Maintain a positive attitude and behavior
- F4. Complete tasks effectively with or without supervision
- F5. Practice good grooming and personal hygiene
- F6. Recognize legal issues in the workplace

G. Demonstrating Knowledge of Effective Interpersonal Skills
- G1. Communicate with others
- G2. Maintain relationships with others

SCANS COMPETENCIES

SCANS *foundation skills* identified by the U.S. Department of Labor describe generic skills needed by nearly everyone. The SCANS *competencies*, however, are more specific in nature and are listed below. (SCANS is the acronym for the Secretary [of Labor]'s Commission on Achieving Necessary Skills.) National VICA's *Total Quality Curriculum* incorporates SCANS competencies and Total Quality Management (TQM) principles in a 17-module set of activities.

1. **Resources**
   - Allocates time
   - Allocates money
   - Allocates material and facility resources
   - Allocates human resources

2. **Interpersonal**
   - Participates as a member of a team
   - Teaches others
   - Serves clients/customers
   - Exercises leadership
   - Negotiates to arrive at a decision
   - Works with cultural diversity

3. **Information**
   - Acquires and evaluates information
   - Organizes and maintains information
   - Interprets and communicates information
   - Uses computers to process information

4. **Systems**
   - Understands systems
   - Monitors and corrects performance
   - Improves and designs systems

5. **Technology**
   - Selects technology
   - Applies technology to task
   - Maintains and troubleshoots equipment

Employability Competencies

Personal Characteristics

Directions: Rate the student by checking the appropriate number on each scale. The ratings should be based on your **observation of the student** rather than grades given in class.

Rating Scale: 3 Above Average
2 Average
1 Below Average

3	2	1

Personal Characteristics

1. **Relations with others**
   (effectiveness in working with students, instructors, and others; cooperation; shows respect)
2. **Dependability**
   (attendance, punctuality; adherence to schedules and deadlines; consistency and results; perseverance)
3. **Work attitudes**
   (willingness to learn; willingness to accept and profit from evaluation; enthusiasm; initiative; commitment; pride in work)
4. **Communication**
   (listening, speaking, and nonverbal skills; effectiveness in communicating with students, teachers, and others)
5. **Personal hygiene/grooming**
   (personal health care and cleanliness; dresses and maintains self appropriately)

Others (specify):

_____

_____

_____

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Job Seeking Techniques

Directions: Evaluate the student by checking the appropriate number or letter to indicate the degree of competency. The rating for each task should reflect **employability readiness** rather than the grades given in class.

Rating Scale: 3 Above Average
2 Average
1 Below Average
N No Exposure

3	2	1	N

Job Seeking Techniques

1. Apply information about self and job opportunities in career decision making
2. Write a resume
3. Prepare a job application form
4. Write letters of application and acceptance
5. Arrange for personal references
6. Apply job search techniques
7. Arrange a job interview
8. Apply job interview techniques
9. Evaluate job offers (actual or simulated)

Others (specify):

_____

_____

_____

Entrepreneurship Awareness

Directions: Evaluate the student by checking the appropriate number or letter to indicate the degree of competency. The rating for each task should reflect **employability readiness** rather than the grades given in class.

Rating Scale: 3 Above Average
2 Average
1 Below Average
N No Exposure

3	2	1	N

Entrepreneurship Awareness

1. Describe five characteristics of a free enterprise economic system (ownership of property, profit motive, risk taking, competition, supply and demand)
2. Name four forms of business ownership (sole proprietorship, partnership, corporation, cooperative)
3. Describe advantages and disadvantages of small business ownership
4. Identify steps necessary to start a business (evaluate need, site selection, marketing plan, financial plan, management plan)
5. Identify business opportunities related to training
6. Identify personal traits of the entrepreneur (versatility, aspirations, energy, integrity, adaptability, etc.)

Others (specify):

_____

_____

_____

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Competency Profile

Instructor: _____

Instructional Program: _____

_____

School: _____

School Address: _____

_____

Student: _____

Address: _____

_____

Telephone: _____

Social Security Number: _____

IN CASE OF EMERGENCY, CONTACT

Name: _____

Telephone: _____

Family Doctor: _____

Telephone: _____

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Date of Enrollment: _____

Date of Withdrawal: _____

Date of Completion: _____

Total Hours Absent: _____

Total Instructional Hours: _____

Total On-The-Job Training Hours: _____

On-The-Job Training/Work Experience

Duration of Employment	Job Title	Job Description	Supervisor's Name	Name/Address of Employer	Telephone

The following profile ratings represent the knowledges, skills, and attitudes that this student has demonstated at a given time under given conditions. It does not necessarily represent certification of future abilities.

This project was supported in whole or in part by funds from the Department of Elementary and Secondary Education, Division of Vocational and Adult Education. However, the opinions expressed herein do not necessarily reflect the position or policies of the Missouri Department of Elementary and Secondary Education, Division of Vocational and Adult Education, and no official endorsement should be inferred.

Directions: Evaluate the student by checking the appropriate number or letter to indicate the degree of competency. The rating for each task should reflect **employability readiness** rather than the grades given in class.

Rating Scale: **3 Mastered** - can work independently with no supervision
2 Requires Supervision - can perform job completely with limited supervision
1 Not Mastered - requires instruction and close supervision
N No Exposure - no experience or knowledge in this area

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NOTES: * = Core competencies (essential for the first day on the job). The numbers in brackets (e.g., A01) reflect the IDs used in computerized tracking software.

3	2	1	N	Revised Missouri Competencies	AWS (EG2.0-95)
				1. Safety	
				*1. Identify and correct or report safety hazards [A01]	
				*2. Identify and utilize proper storage for flammables [A02]	
				*3. Identify and demonstrate correct use of fire extinguishers [A03]	
				*4. Identify ventilation hazards and take corrective action [A04]	
				*5. Observe and adhere to safety labels [A05]	
				*6. Maintain, use and safely work with machines, tooling and equipment [A06]	
				*7. Use power equipment, grinder, drill press and power saw safely/correctly [A11]	
				*8. Identify confined space and fall protection hazards [A16]	
				2. Basic Skills	
				*1. Obtain and use reference books and charts [A07]	
				*2. Apply math to solution of welding problems - whole numbers, fractions, decimals, rounding numbers [A08]	
				3. Apply math to solution of welding problems - geometry and trigonometry [A17]	
				*4. Identify basic hand tools [A09]	
				*5. Select, use and care for hand tools [A10]	
				*6. Identify and store electrodes/filler materials [A12]	
				*7. Read and implement welding procedures [A13]	
				*8. Identify basic power sources [A14]	
				9. Identify structural shapes, sizes and weights [A18]	
				3. Print Reading	
				*1. Read and interpret basic prints [B01]	B1
				*2. Interpret welding symbols, abbreviations and joint designs [B02]	B2
				3. Construct an exercise(s) using basic print and sketch [B03]	
				4. Make sketches - pictorial and orthographic [B04]	B1
				5. Convert English measurements to metric and vice-versa [B06]	
				4. Layout, Fit-Up and Fabrication	
				1. Make layout of material for plate, structural and pipe fabrication [D01]	
				*2. Prepare material for weld procedure specification (WPS) [D02]	
				3. Fabricate parts from a drawing or sketch [D03]	B3
				5. Oxyfuel Cutting/Brazing	
				*1. Demonstrate safety procedures for oxyfuel cutting/brazing [C01]	D1-1, D2-1
				2. Describe theory of oxyfuel cutting/brazing [C20]	
				*3. Identify types of fuel gases and their applications [C02]	

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3	2	1	N	Revised Missouri Competencies	AWS (EG2.0-95)
				Gas Metal Arc Welding - Plate and Pipe - *Continued*	
				18. Make weld in 5G position, vertical up, with carbon steel (pipe) [I30]	
				19. Make weld in 6G position, vertical up, with carbon steel (pipe) [I46]	
				*20. Identify gas metal arc welding problems, their causes and take corrective action [I32]	C2-2
				*21. Prepare gas metal arc weld for test [I33]	
				11. Flux Cored Arc Welding	
				*1. Demonstrate safety procedures for flux cored arc welding [O01]	C3-1
				2. Describe theory of flux cored arc welding [O02]	
				*3. Identify, select and safely handle shielding gases for various metals [O03]	C3-3
				*4. Adjust current, voltage, pulse, wire feed rate and gas flow [O04]	C3-3, C3-4
				*5. Identify, select and set up equipment [O05]	C3-2, C3-3
				*6. Identify and select cored wire electrodes for carbon steel and stainless steel [O06]	C3-3
				*7. Make weld in 2F position with carbon steel and cored wire (qualifies 1F position) [O07]	C3-5
				8. Make weld in 3F position, vertical up, with carbon steel and cored wire [O08]	C3-5
				*9. Make weld in 2G position with carbon steel and cored wire (qualifies 1G position) [O09]	C3-6
				10. Make weld in 3G position, vertical up, with carbon steel and cored wire [O10]	C3-6
				11. Identify welding problems, their causes and take corrective action [O11]	
				12. Prepare flux cored arc weld for test [O12]	
				12. Gas Tungsten Arc Welding (Carbon Steel, Stainless Steel, Aluminum)	
				*1. Demonstrate safety procedures for gas tungsten arc welding [J01]	C4-1
				2. Describe theory of gas tungsten arc welding [J35]	
				*3. Identify, select and set up equipment and explain function [J02]	C4-2, C4-3
				*4. Identify, select and safely handle shielding gases [J03]	C4-3
				*5. Identify, select, shape and install tungsten electrode [J04]	C4-3
				*6. Adjust polarity, pulse, current, gas flow setting and post flow timer and strike arc [J05]	C4-3, C4-4
				7. Identify joint design and prepare material for weld procedure specification (WPS) [J06]	
				8. Select filler rod for base material [J07]	C4-3
				9. Make weld in 2F position, stainless steel (qualifies 1F position) [J15]	C4-9
				10. Make weld in 2F position, aluminum (qualifies 1F position) [J16]	C4-7
				11. Make weld in 2F position, carbon steel (qualifies 1F position) [J17]	C4-5
				*12. Make weld in 2F position, stainless steel [J18]	C4-9

				properly [C03]	D1-3
				*5. Identify, select and set up oxyfuel welding and cutting equipment [C04]	D1-3, D2-3
				*6. Light and adjust flame for welding and cutting [C05]	D1-4, D2-4
				*7. Pierce holes and cut slots [C06]	D1-5, D1-6, D2-5
				*8. Make straight 90-degree and beveled cuts on mild steel plate and pipe [C07]	D1-5, D1-7, D2-5, D2-6
				9. Make circle cuts - off hand and with guide [C08]	D1-6
				10. Lay out, cut and fit materials (such as pipe, plate and structural shapes) [C09]	D1-6
				11. Braze weld materials [C21]	
				*12. Prepare coupon for testing and pass visual test [C17]	
				13. Identify brazing and cutting problems, their causes and take corrective action [C18]	D1-2, D2-2
				14. Identify and select correct brazing rod and flux, if applicable [C19]	

3	2	1	N	6. Shielded Metal Arc - General	
				*1. Demonstrate safety procedures for shielded metal arc welding [E01]	C1-1
				2. Describe theory of shielded metal arc welding [E02]	
				*3. Select polarity and current for electrode [E17]	C1-3
				*4. Identify and make proper electrode selection for base material and material thickness or follow WPS (weld procedure specification) [E04]	C1-3
				*5. Identify joint design and prepare material for WPS [E05]	C1-3
				6. Identify shielded metal arc welding problems, their causes and take corrective action [E06]	C1-2, C1-3
				*7. Build pad of beads in horizontal position (qualifies flat position) [E18]	C1-4
				8. Build pad of beads in vertical position upward [E19]	C1-4
				*9. Visually inspect shielded metal arc weld [E20]	

3	2	1	N	7. Shielded Metal Arc - 3/8" Plate	
				*1. Make weld in 2F position with E-6010 or E-6011 (qualifies 1F position) [F04]	C1-5
				*2. Make weld in 2F position with E-7024 [F05]	C1-5
				*3. Make weld in 2F position with E-7018 (qualifies 1F position) [F06]	C1-5
				4. Make weld in 3F position, vertical up, with E-6010 or E-6011 [F21]	C1-5
				5. Make weld in 3F position, vertical up, with E-7018 [F22]	C1-5
				6. Make weld in 4F position with E-6010 or E-6011 [F09]	C1-5
				7. Make weld in 4F position with E-7018 [F10]	C1-5
				8. Make weld in 2G position with E-6010 or E-6011 (qualifies 1G position) [F14]	C1-6, C1-7
				9. Make weld in 2G position with E-7018 (qualifies 1G position) [F16]	C1-6, C1-7
				10. Make weld in 3G position, vertical up, with E-6010 or E-6011 [F23]	C1-6, C1-7
				11. Make weld in 3G position, vertical up, with E-7018 [F24]	C1-6, C1-7
				12. Make weld in 4G position with E-6010 or E-6011 [F19]	C1-6
				13. Make weld in 4G position with E-7018 [F20]	C1-6

3	2	1	N	8. Shielded Metal Arc - Pipe (2"- 6" Dia.)	
				*1. Make weld in 1G position with E-6010 or E-6011 [G01]	C1-6
				*2. Make weld in 1G position with E-7018 [G03]	C1-6
				3. Make weld in 2G position with E-6010 or E-6011 [G04]	C1-6
				4. Make weld in 2G position with E-7018 [G06]	C1-6
				5. Make weld in 5G position, vertical up, with E-6010 or E-6011 [G11]	C1-6

				14. Make weld in 3F position, carbon steel [J20]	C4-5
				15. Make weld in 2G position, stainless steel (qualifies 1G position) [J27]	C4-10
				16. Make weld in 2G position, aluminum (qualifies 1G position) [J28]	C4-8
				17. Make weld in 2G position, carbon steel (qualifies 1G position) [J29]	C4-6
				18. Make weld in 3G position, vertical up, on stainless steel [J30]	
				19. Make weld in 3G position, vertical up, on aluminum [J31]	
				20. Make weld in 3G position, vertical up, on carbon steel [J32]	C4-6
				21. Make weld in 4G position with carbon steel [J36]	C4-6
				22. Identify gas tungsten arc welding problems, their causes and take corrective action [J33]	C4-2
				23. Prepare gas tungsten arc weld for test [J34]	

3	2	1	N	13. Plasma Arc Cutting	
				*1. Demonstrate safety procedures for plasma cutting [K01]	E2-1
				*2. Describe theory of plasma cutting [K10]	
				*3. Set up and operate plasma cutting equipment [K02]	E2-3, E2-4
				*4. Lay out and make straight line cuts [K03]	
				*5. Lay out and make bevel cuts [K04]	
				6. Lay out and make circular cuts [K05]	E2-5
				7. Lay out and make pattern cuts [K06]	E2-5
				8. Lay out, cut and bevel pipe to a 30-37 1/2 degree angle [K07]	
				*9. Lay out and cut square and round solid stock [K08]	

3	2	1	N	14. Metallurgy and Heat Treating	
				*1. Demonstrate safety procedures for metallurgy and heat treating [L01]	
				2. Identify the classification and physical properties of ferrous and nonferrous metals [L02]	
				3. Identify and apply principles of preheating and postheating [L03]	
				4. Describe and apply principles of metallurgy in annealing, hardening and tempering [L04]	
				5. Describe methods of testing metals [L05]	
				6. Identify types of ferrous metal by spark test [L06]	
				7. Describe the relationship between the hardness test of weld, heat-affected zone and base metal, and interpret the results [L07]	

3	2	1	N	15. Carbon Arc Gouging	
				*1. Demonstrate safety procedures for carbon arc gouging [M01]	E1-1
				2. Describe theory of carbon arc gouging [M04]	
				*3. Identify and select electrode size, polarity, current and air pressure [M05]	
				4. Set up and operate carbon arc gouging equipment [M02]	E1-2, E1-3, E1-4
				*5. Remove weld material/backgouge [M03]	E1-4, E1-5

3	2	1	N	16. Visual Weld Testing	
				*1. Prepare sample for visual test per appropriate standard [P01]	C1-7, F1-1, F1-2
				*2. Inspect for undercut, overlap, porosity, slag, spatter and weld size [P02]	C1-7, F1-2
				*3. Identify defects and take corrective action based on visual test [P03]	C1-7, F1-2

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3	2	1	N	17. Destructive Testing	
				1. Prepare coupon for bend test per appropriate standard [Q01]	
				2. Perform destructive test on welds [Q02]	

3	2	1	N	9. Shielded Metal Arc - 16 Ga. Steel	
				*1. Make weld in 1F position with E-6010 or E-6011 [H01]	C1-5
				*2. Make weld in 1F position with E-6013 [H17]	C1-5
				*3. Make weld in 2F position with E-6010 or E-6011 [H03]	C1-5
				*4. Make weld in 2F position with E-6013 [H18]	C1-5
				5. Make weld in 3F position with E-6010 or E-6011 [H05]	C1-5
				6. Make weld in 3F position with E-6013 [H06]	C1-5
				7. Make weld in 4F position with E-6010 or E-6011 [H07]	C1-5
				8. Make weld in 4F position with E-6013 [H08]	C1-5
				*9. Make butt weld in horizontal position with E-6010 or E-6011 (qualifies flat position) [H11]	
				*10. Make butt weld in horizontal position with E-6013 (qualifies flat position) [H19]	
				11. Make butt weld in vertical down position with E-6010 or E-6011 [H13]	
				12. Make butt weld in vertical down position with E-6013 [H20]	
				13. Make butt weld in overhead position with E-6010 or E-6011 [H15]	
				14. Make butt weld in overhead position with E-6013 [H21]	

3	2	1	N	10. Gas Metal Arc Welding - Plate and Pipe	
				*1. Demonstrate safety procedures for gas metal arc welding [I01]	C2-1
				*2. Describe theory of gas metal arc welding [I34]	
				*3. Identify, select and safely handle shielding gases for various metals [I02]	C2-3
				*4. Adjust current, voltage, pulse, wire feed rate and gas flow [I03]	C2-4, C2-7
				*5. Identify, select and set up equipment [I04]	C2-2, C2-3
				*6. Identify and select solid wire electrode for carbon steel, aluminum and stainless steel [I35]	C2-3
				*7. Make weld in 2F position with carbon steel and solid wire (qualifies 1F position) [I36]	C2-5, C2-7
				8. Make weld in 2F position with aluminum (qualifies 1F position) [I18]	
				9. Make weld in 2F position with stainless steel (qualifies 1F position) [I19]	C3-6
				10. Make weld in 3F position, vertical up, with material 3/16" or thicker [I37]	C2-5
				11. Make weld in 3F position, vertical down, with carbon steel thinner than 3/16" and solid wire [I38]	C2-5
				12. Make weld in 4F position with solid wire [I39]	C2-5
				13. Make butt weld in 1G position with aluminum [I40]	
				14. Make butt weld in 1G position with stainless steel [I41]	
				*15. Make weld in 2G position with solid wire (qualifies 1G position) [I42]	C2-6, C2-15
				16. Make weld in 3G position, vertical up, with carbon steel 3/16" or thicker [I27]	C2-6
				17. Make weld in 3G position, vertical down, with carbon steel less than 3/16" thick [I28]	C2-6

				2. Perform non-destructive test per appropriate standard [R02]	C1-7
				3. Inspect for undercut, overlap, porosity, slag, spatter and surface cracks [R03]	C1-7
				4. Identify defects and take corrective action based on non-destructive test [R04]	

3	2	1	N	19. Leadership Competencies**	
				1. Demonstrate an understanding of VICA, its structure and activities [N01]	
				2. Demonstrate an understanding of one's personal values [N02]	
				3. Perform tasks related to effective personal management skills [N03]	
				4. Demonstrate interpersonal skills [N04]	
				5. Demonstrate etiquette and courtesy [N05]	
				6. Demonstrate effectiveness in oral and written communication [N06]	
				7. Develop and maintain a code of professional ethics [N07]	
				8. Maintain a good professional appearance [N08]	
				9. Perform basic tasks related to securing and terminating employment [N09]	
				10. Perform basic parliamentary procedures in a group meeting [N10]	

**NOTE: These competencies are addressed in the Missouri VICA Curriculum Guide lessons.

3	2	1	N	Areas of Specialization
				1. _____
				2. _____
				3. _____
				4. _____
				5. _____
				6. _____
				7. _____
				8. _____
				9. _____
				10. _____

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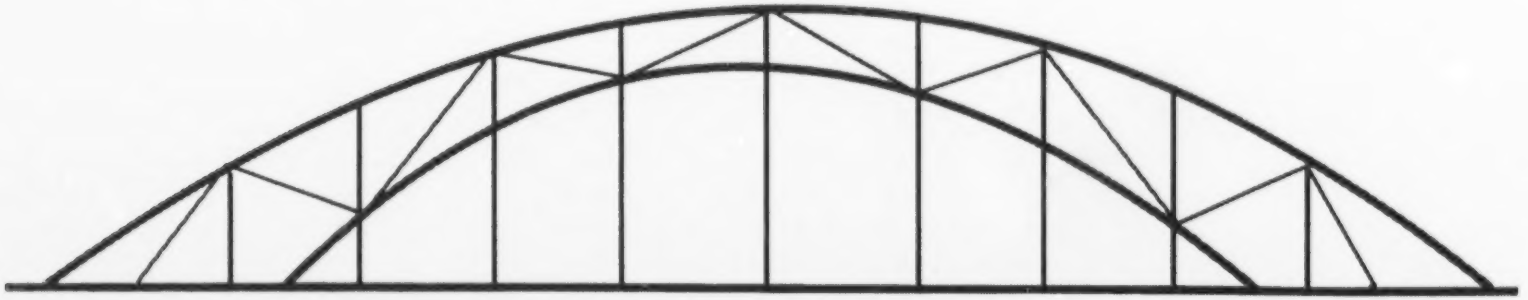
Performance Indicators for Welding:

A Bridge to Selected Instructional Materials



• National Skill Standards • Missouri Competencies • Show-Me Standards
• All Aspects of the Industry Objectives • VICA/SCANS Competencies

Instructional Materials Laboratory
University of Missouri-Columbia

February 1996

INTRODUCTION

This curriculum project includes two parts: an updated Welding competency profile and this performance indicator document. The updated profile contains more information than before. It is cross-referenced to national skill standards (see page 13); core/essential skills are indicated by an asterisk (*); and task IDs for VAMS (Missouri's Vocational Administrative Management System) are shown in brackets.

The Performance Indicator Chart connects technical welding skills with other important, but more general, skills needed by students. This document also provides instructors and administrators with links between newly updated welding competencies and (1) previous Mo. competencies, (2) Show-Me Standards for students in Missouri public schools, (3) All Aspects of the Industry objectives and (4) SCANS competencies (addressed in National VICA's *Total Quality Curriculum).* These sets of skills are listed after the Performance Indicator Chart.

To use the Welding Performance Indicator Chart, consider the following example. Duty bands (umbrella-like categories for competencies) are in **bold** type and shaded.

MISSOURI COMPETENCY	Previous Mo. Competencies	Show-Me Standards (Page 15 ↘)	AAOI Objectives (Page 16 ↘)	VICA/SCANS Competencies (Page 19 ↘)
1. Safety				
*1.8 Identify confined space and fall protection hazards [A16]	A1	Goals 1, 2, 3	D13, E5, H2	3, 4

The second column (Previous Mo. Competencies) is helpful for anyone with curriculum tied to the previous Missouri competency list. As indicated by the chart, competency #8 in Safety (Identify confined space and fall protection hazards) is related to previous competency A1 (Identify and correct or report safety hazards). Safety #8 is also related to the first three Show-Me Standards, and so on.

For more detail, obtain or contact the following resources.

- *Guide for the Training and Qualification of Welding Personnel: Entry Level Welder (AWS EG2.0-95).* Miami: American Welding Society, 1995.* Contact:
  AWS Education Department, 550 N.W. LeJeune Road, Miami, FL 33126, 800/443-WELD, FAX 305/443=6445.
- *Total Quality Curriculum.* Leesburg, VA: National VICA, 1993.* Contact:
  Education Department, National VICA, PO Box 3000, Leesburg, VA 22075, 800/321-VICA (8422).
- Welding competency profile (70-6300-C), test-item bank (70-6300-E) and curriculum guide (70-6300-I, S, W). Contact:
  Instructional Materials Laboratory, 2316 Industrial Drive, Columbia, MO 65211, 800/669-2465, FAX 573/882=1992.
- *Pre-Employment/Work-Maturity Skills Instructional Resource Guide (30-6000-I).* University of Missouri-Columbia: Instructional Materials Laboratory, 1992. Contact:
  IML (see above)

• *All Aspects of the Industry (65-9000-I).* University of Missouri-Columbia: Instructional Materials Laboratory, 1994. Contact:
IML (see above)
• *Learning a Living: A Blueprint for High Performance (A SCANS Report for America 2000).* Washington, D.C., U.S. Department of Labor, 1992. *
• VIMS/VAMS Support Center, 324 Townsend Hall, UMC, Columbia, MO 65211, 573/882-2951, FAX 573/884=5455.

*These resources are available to Missouri educators for free loan from the Missouri Vocational Resource Center (MVRC), University of Missouri-Columbia, 8 London Hall, Columbia, MO 65211 (800/392-7217, FAX 573/882=9935).

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WELDING PERFORMANCE INDICATOR CHART

NOTE: Numbers in brackets (e.g., A01) represent the IDs used in computerized tracking software.
* = Core competencies (essential for the first day on the job)

Missouri Competency	Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	VICA/SCANS Competencies
1. Safety				
*1.1 Identify and correct or report safety hazards [A01]	A1 (same)	Goals 1, 2, 3, 4	E5, H4	3, 4
*1.2 Identify and utilize proper storage for flammables [A02]	A2 (same)	Goals 1, 3, 4	E5, H4	3, 4
*1.3 Identify and demonstrate correct use of fire extinguishers [A03]	A3 (same)	Goals 1, 3, 4	E5, H4	3, 4, 5
*1.4 Identify ventilation hazards and take corrective action [A04]	A4 (same)	Goals 1, 3, 4	D13, E5, H2	3, 4
*1.5 Observe and adhere to safety labels [A05]	A5 (same)	Goals 1, 4	E5, H1	3, 4
*1.6 Maintain, use and safely work with machines, tooling and equipment [A06]	A6	Goals 1, 4	E5, H9	5
*1.7 Use power equipment, grinder, drill press and power saw safely/correctly [A11]	A11	Goals 1, 4	D13, E5	4, 5
*1.8 Identify confined space and fall protection hazards [A16]	A1	Goals 1, 2, 3	D13, E5, H2	3, 4
2. Basic Skills				
*2.1 Obtain and use reference books and charts [A07]	A7 (same)	Goals 1, 3	D15, E5	3
*2.2 Apply math to solution of welding problems - whole numbers, fractions, decimals, rounding numbers [A08]	A8	Goals 1, 3	D1, D2	3, 5
2.3 Apply math to solution of welding problems - geometry and trigonometry [A17]	A8	Goals 1, 3	D1, D2	3, 5
*2.4 Identify basic hand tools [A09]	A9 (same)	Goals 1, 2	E5	3, 5
*2.5 Select, use and care for hand tools [A10]	A10 (same)	Goals 1, 4	E5	5
*2.6 Identify and store electrodes/filler materials [A12]	A12	Goals 1, 2, 4	E5	3
*2.7 Read and implement welding procedures [A13]	A13 (same)	Goals 1, 4	E5	3
*2.8 Identify basic power sources [A14]	A14 (same)	Goals 1, 2	E5	3, 5
2.9 Identify structural shapes, sizes and weights [A18]	B5 (same)	Goals 1, 2	E5	3
3. Print Reading				
*3.1 Read and interpret basic prints [B01]	B1 (same)	Goals 1, 3	D7	3
*3.2 Interpret welding symbols, abbreviations and joint designs [B02]	B2 (same)	Goals 1, 3	D7	3
3.3 Construct an exercise(s) using basic print and sketch [B03]	B3 (same)	Goals 1, 2, 3, 4	D1, D2, D7	3, 5

Missouri Competency		Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	VICA/SCANS Competencies
3.4	Make sketches - pictorial and orthographic [B04]	B4 (same)	Goals 1, 2, 3, 4	D1, D7, E5	3
3.5	Convert English measurements to metric and vice-versa [B06]	A8	Goals 1, 3	D1	3, 5
4. Layout, Fit-Up and Fabrication					
4.1	Make layout of material for plate, structural and pipe fabrication [D01]	D1 (same)	Goals 1, 3, 4	D1, D2, D7	3, 5
*4.2	Prepare material for weld procedure specification (WPS) [D02]	B3	Goals 1, 4	D7, D16, E5	3, 4, 5
4.3	Fabricate parts from a drawing or sketch [D03]	B3	Goals 1, 3, 4	D1, D2, D7, E5	3, 5
5. Oxyfuel Cutting/Brazing					
*5.1	Demonstrate safety procedures for oxyfuel cutting/brazing [C01]	C1	Goals 1, 2, 3, 4	E5, H2, H9	3, 4
5.2	Describe theory of oxyfuel cutting/brazing [C20]		Goals 1, 2	D3, D15, E5	3
*5.3	Identify types of fuel gases and their applications [C02]	C2	Goals 1, 2	D15, E5	3, 5
*5.4	Handle, make preliminary safety inspection and store cylinders properly [C03]	C3 (same)	Goals 1, 3, 4	E5, H1	3, 5
*5.5	Identify, select and set up oxyfuel welding and cutting equipment [C04]	C4 (same)	Goals 1, 3, 4	D15, E5	3, 5
*5.6	Light and adjust flame for welding and cutting [C05]	C5 (same)	Goals 1, 4	D15, E5	3, 5
*5.7	Pierce holes and cut slots [C06]	C6 (same)	Goals 1, 3, 4	D15, E5	1, 5
*5.8	Make straight 90 degree and beveled cuts on mild steel plate and pipe [C07]	C7 (same)	Goals 1, 3, 4	D1, D2, D15, E5	1, 5
5.9	Make circle cuts - off hand and with guide [C08]	C8 (same)	Goals 1, 3, 4	D1, D15, E5	1, 5
5.10	Lay out, cut and fit materials (such as pipe, plate and structural shapes) [C09]	C9	Goals 1, 3, 4	D1, D2, D15, E5	1, 5
5.11	Braze weld materials [C21]	C15, C16	Goals 1, 3, 4	D15, E5	5
*5.12	Prepare coupon for testing and pass visual test [C17]	C17	Goals 1, 3, 4	D15, E5	5
5.13	Identify brazing and cutting problems, their causes and take corrective action [C18]	C18	Goals 1, 2, 3, 4	D13, E5	3,4,5
5.14	Identify and select correct brazing rod and flux, if applicable [C19]	C19	Goals 1, 2, 3, 4	D15, E5	3, 4, 5
6. Shielded Metal Arc - General					
*6.1	Demonstrate safety procedures for shielded metal arc welding [E01]	E1	Goals 1, 2, 3, 4	E5, H2, H9	3, 4
6.2	Describe theory of shielded metal arc welding [E02]	E2 (same)	Goals 1, 2	D15, E5	2, 3
*6.3	Select polarity and current for electrode [E17]	E3	Goals 1, 3, 4	D15, E5	3, 5
*6.4	Identify and make proper electrode selection for base material and material thickness or follow WPS (weld procedure specification) [E04]	E4	Goals 1, 2, 3, 4	D15, E5	3, 5

Missouri Competency		Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	VICA/SCANS Competencies
*6.5	Identify joint design and prepare material for WPS [E05]	E5	Goals 1, 2, 3, 4	D15, D16, E5	3, 5
6.6	Identify shielded metal arc welding problems, their causes and take corrective action [E06]	E6	Goals 1, 2, 3, 4	D13, D15, E5	3, 4, 5
*6.7	Build pad of beads in horizontal position (qualifies flat position) [E18]	E10, E11	Goals 1, 3, 4	D15, E5	5
6.8	Build pad of beads in vertical position upward [E19]	E12, E13	Goals 1, 3, 4	D15, E5	5
*6.9	Visually inspect shielded metal arc weld [E20]		Goals 1, 4	D15, E5	3, 5
7. Shielded Metal Arc - 3/8" Plate					
*7.1	Make weld in 2F position with E-6010 or E-6011 (qualifies 1F position) [F04]	F4	Goals 1, 3, 4	D7, D15, D16, E5	5
*7.2	Make weld in 2F position with E-7024 [F05]	F5 (same)	Goals 1, 3, 4	D15, E5	5
*7.3	Make weld in 2F position with E-7018 (qualifies 1F position) [F06]	F6	Goals 1, 3, 4	D7, D15, D16, E5	5
7.4	Make weld in 3F position, vertical up, with E-6010 or E-6011 [F21]	F7	Goals 1, 3, 4	D15, E5	5
7.5	Make weld in 3F position, vertical up, with E-7018 [F22]	F8	Goals 1, 3, 4	D15, E5	5
7.6	Make weld in 4F position with E-6010 or E-6011 [F09]	F9 (same)	Goals 1, 3, 4	D15, E5	5
7.7	Make weld in 4F position with E-7018 [F10]	F10 (same)	Goals 1, 3, 4	D15, E5	5
7.8	Make weld in 2G position with E-6010 or E-6011 (qualifies 1G position) [F14]	F14	Goals 1, 3, 4	D7, D15, D16, E5	5
7.9	Make weld in 2G position with E-7018 (qualifies 1G position) [F16]	F16	Goals 1, 3, 4	D7, D15, D16, E5	5
7.10	Make weld in 3G position, vertical up, with E-6010 or E-6011 [F23]	F17	Goals 1, 3, 4	D15, E5	5
7.11	Make weld in 3G position, vertical up, with E-7018 [F24]	F18	Goals 1, 3, 4	D15, E5	5
7.12	Make weld in 4G position with E-6010 or E-6011 [F19]	F19 (same)	Goals 1, 3, 4	D15, E5	5
7.13	Make weld in 4G position with E-7018 [F20]	F20 (same)	Goals 1, 3, 4	D15, E5	5
8. Shielded Metal Arc - Pipe (2"-6" Dia.)					
*8.1	Make weld in 1G position with E-6010 or E-6011 [G01]	G1 (same)	Goals 1, 3, 4	D15, E5	5
*8.2	Make weld in 1G position with E-7018 [G03]	G3 (same)	Goals 1, 3, 4	D15, E5	5
8.3	Make weld in 2G position with E-6010 or E-6011 [G04]	G4 (same)	Goals 1, 3, 4	D15, E5	5
8.4	Make weld in 2G position with E-7018 [G06]	G6 (same)	Goals 1, 3, 4	D15, E5	5
8.5	Make weld in 5G position, vertical up, with E-6010 or E-6011 [G11]	G7	Goals 1, 3, 4	D15, E5	5
8.6	Make weld in 5G position, vertical up, with E-7018 [G12]	G8	Goals 1, 3, 4	D15, E5	5

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Missouri Competency		Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	VICA/SCANS Competencies
8.7	Make weld in 5G position, vertical down, with E-6010 or E-6011 [G13]	G7	Goals 1, 3, 4	D15, E5	5
8.8	Make weld in 6G position, vertical up, with E-6010 or E-6011 [G14]	G9	Goals 1, 3, 4	D15, E5	5
8.9	Make weld in 6G position, vertical up, with E-7018 [G15]	G10	Goals 1, 3, 4	D15, E5	5
9. Shielded Metal Arc - 16 Ga. Steel					
*9.1	Make weld in 1F position with E-6010 or E-6011 [H01]	H1 (same)	Goals 1, 3, 4	D15, E5	5
*9.2	Make weld in 1F position with E-6013 [H17]	H2	Goals 1, 3, 4	D15, E5	5
*9.3	Make weld in 2F position with E-6010 or E-6011 [H03]	H3 (same)	Goals 1, 3, 4	D15, E5	5
*9.4	Make weld in 2F position with E-6013 [H18]	H4	Goals 1, 3, 4	D15, E5	5
9.5	Make weld in 3F position with E-6010 or E-6011 [H05]	H5 (same)	Goals 1, 3, 4	D15, E5	5
9.6	Make weld in 3F position with E-6013 [H06]	H6	Goals 1, 3, 4	D15, E5	5
9.7	Make weld in 4F position with E-6010 or E-6011 [H07]	H7 (same)	Goals 1, 3, 4	D15, E5	5
9.8	Make weld in 4F position with E-6013 [H08]	H7	Goals 1, 3, 4	D15, E5	5
*9.9	Make butt weld in horizontal position with E-6010 or E-6011 (qualifies flat position) [H11]	H11	Goals 1, 3, 4	D7, D15, D16, E5	5
*9.10	Make butt weld in horizontal position with E-6013 (qualifies flat position) [H19]	H12	Goals 1, 3, 4	D7, D15, D16, E5	5
9.11	Make butt weld in vertical down position with E-6010 or E-6011 [H13]	H13	Goals 1, 3, 4	D15, E5	5
9.12	Make butt weld in vertical down position with E-6013 [H20]	H14	Goals 1, 3, 4	D15, E5	5
9.13	Make butt weld in overhead position with E-6010 or E-6011 [H15]	H15	Goals 1, 3, 4	D15, E5	5
9.14	Make butt weld in overhead position with E-6013 [H21]	H16	Goals 1, 3, 4	D15, E5	5
10. Gas Metal Arc Welding - Plate and Pipe					
*10.1	Demonstrate safety procedures for gas metal arc welding [I01]	I1	Goals 1, 2, 3, 4	E5, H2, H4, H9	3, 4
*10.2	Describe theory of gas metal arc welding [I34]		Goals 1, 2	D15, E5	3
*10.3	Identify, select and safely handle shielding gases for various metals [I02]	I2	Goals 1, 3, 4	D15, E5, H1	3, 5
*10.4	Adjust current, voltage, pulse, wire feed rate and gas flow [I03]	I3	Goals 1, 3, 4	D1, D15, E5	3, 5
*10.5	Identify, select and set up equipment [I04]	I4	Goals 1, 3, 4	D15, E5	3, 5
*10.6	Identify and select solid wire electrode for carbon steel, aluminum and stainless steel [I35]	I4, I5, I7	Goals 1, 4	D15, E5	5

Missouri Competency	Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	VICA/SCANS Competencies
*10.7 Make weld in 2F position with carbon steel and solid wire (qualifies 1F position) [I36]	I17	Goals 1, 3, 4	D7, D15, D16, E5	5
10.8 Make weld in 2F position with aluminum (qualifies 1F position) [I18]	I18	Goals 1, 3, 4	D7, D15, D16, E5	5
10.9 Make weld in 2F position with stainless steel (qualifies 1F position) [I19]	I19	Goals 1, 3, 4	D7, D15, D16, E5	5
10.10 Make weld in 3F position, vertical up, with material 3/16" or thicker [I37]	I20	Goals 1, 3, 4	D15, E5	5
10.11 Make weld in 3F position, vertical down, with carbon steel thinner than 3/16" and solid wire [I38]		Goals 1, 3, 4	D15, E5	5
10.12 Make weld in 4F position with solid wire [I39]	I21	Goals 1, 3, 4	D15, E5	5
10.13 Make butt weld in 1G position with aluminum [I40]		Goals 1, 3, 4	D15, E5	5
10.14 Make butt weld in 1G position with stainless steel [I41]		Goals 1, 3, 4	D15, E5	5
*10.15 Make weld in 2G position with solid wire (qualifies 1G position) [I42]	I26	Goals 1, 3, 4	D7, D15, D16, E5	5
10.16 Make weld in 3G position, vertical up, with carbon steel 3/16" or thicker [I27]	I27	Goals 1, 3, 4	D15, E5	5
10.17 Make weld in 3G position, vertical down, with carbon steel less than 3/16" thick [I28]	I28	Goals 1, 3, 4	D15, E5	5
10.18 Make weld in 5G position, vertical up, with carbon steel (pipe) [I30]	I30	Goals 1, 3, 4	D15, E5	5
10.19 Make weld in 6G position, vertical up, with carbon steel (pipe) [I46]	I31	Goals 1, 3, 4	D15, E5	5
*10.20 Identify gas metal arc welding problems, their causes and take corrective action [I32]	I32	Goals 1, 3	D13, D15, E5	4, 5
*10.21 Prepare gas metal arc weld for test [I33]	I33	Goals 1, 3, 4	D7, D15, D16, E5	5
11. Flux Cored Arc Welding				
*11.1 Demonstrate safety procedures for flux cored arc welding [O01]	I1	Goals 1, 2, 3, 4	E5, H2, H4, H9	3, 4
11.2 Describe theory of flux cored arc welding [O02]	I8	Goals 1, 2	D15, E5	3
*11.3 Identify, select and safely handle shielding gases for various metals [O03]	I2	Goals 1, 4	D15, E5, H1	3, 5
*11.4 Adjust current, voltage, pulse, wire feed rate and gas flow [O04]	I3	Goals 1, 2, 3, 4	D15, E5	3, 5
*11.5 Identify, select and set up equipment [O05]	I4	Goals 1, 4	D15, E5	3, 5
*11.6 Identify and select cored wire electrodes for carbon steel and stainless steel [O06]	I8, I9, I12	Goals 1, 4	D15, E5	3, 5
*11.7 Make weld in 2F position with carbon steel and cored wire (qualifies 1F position) [O07]	I14, I17	Goals 1, 3, 4	D7, D15, D16, E5	5
11.8 Make weld in 3F position, vertical up, with carbon steel and cored wire [O08]	I20	Goals 1, 3, 4	D15, E5	5

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Missouri Competency	Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	VICA/SCANS Competencies
*11.9 Make weld in 2G position with carbon steel and cored wire (qualifies 1G position) [O09]	I26	Goals 1, 3, 4	D7, D15, D16, E5	5
11.10 Make weld in 3G position, vertical up, with carbon steel and cored wire [O10]	I27	Goals 1, 3, 4	D15, E5	5
11.11 Identify welding problems, their causes and take corrective action [O11]	I32 (same)	Goals 1,2, 3, 4	D13, D15, E5	3, 4, 5
11.12 Prepare flux cored arc weld for test [O12]	I33	Goals 1, 3, 4	D7, D15, D16, E5	5
12. Gas Tungsten Arc Welding (Carbon Steel, Stainless Steel, Aluminum)				
*12.1 Demonstrate safety procedures for gas tungsten arc welding [J01]	J1	Goals 1, 2, 3, 4	H2	3, 4
12.2 Describe theory of gas tungsten arc welding [J35]		Goals 1, 2	D3, D15, E5	3
*12.3 Identify, select and set up equipment and explain function [J02]	J2 (same)	Goals 1, 3, 4	D3, D15, E5, H2	3, 5
*12.4 Identify, select and safely handle shielding gases [J03]	J3 (same)	Goals 1, 2, 4	D15, E5, H2	3, 5
*12.5 Identify, select, shape and install tungsten electrode [J04]	J4 (same)	Goals 1, 2, 4	D15, E5	3, 5
*12.6 Adjust polarity, pulse, current, gas flow setting and post flow timer and strike arc [J05]	J5	Goals 1, 4	D1, D15, E5	3, 5
12.7 Identify joint design and prepare material for weld procedure specification (WPS) [J06]	J6	Goals 1, 4	D7, D15, D16, E5	3, 5
12.8 Select filler rod for base material [J07]	J7 (same)	Goals 1, 4	D15, E5	3, 5
12.9 Make weld in 2F position, stainless steel (qualifies 1F position) [J15]	J15	Goals 1, 3, 4	D7, D15, D16, E5	5
12.10 Make weld in 2F position, aluminum (qualifies 1F position) [J16]	J16	Goals 1, 3, 4	D7, D15, D16, E5	5
12.11 Make weld in 2F position, carbon steel (qualifies 1F position) [J17]	J17	Goals 1, 3, 4	D7, D15, D16, E5	5
12.12 Make weld in 3F position, stainless steel [J18]	J18 (same)	Goals 1, 3, 4	D15, E5	5
12.13 Make weld in 3F position, aluminum [J19]	J19 (same)	Goals 1, 3, 4	D15, E5	5
12.14 Make weld in 3F position, carbon steel [J20]	J20 (same)	Goals 1, 3, 4	D15, E5	5
12.15 Make weld in 2G position, stainless steel (qualifies 1G position) [J27]	J27	Goals 1, 3, 4	D7, D15, D16, E5	5
12.16 Make weld in 2G position, aluminum (qualifies 1G position) [J28]	J28	Goals 1, 3, 4	D7, D15, D16, E5	5
12.17 Make weld in 2G position, carbon steel (qualifies 1G position) [J29]	J29	Goals 1, 3, 4	D7, D15, D16, E5	5
12.18 Make weld in 3G position, vertical up, on stainless steel [J30]	J30	Goals 1, 3, 4	D15, E5	5
12.19 Make weld in 3G position, vertical up, on aluminum [J31]	J31	Goals 1, 3, 4	D15, E5	5
12.20 Make weld in 3G position, vertical up, on carbon steel [J32]	J32	Goals 1, 3, 4	D15, E5	5

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Missouri Competency	Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	VICA/SCANS Competencies
12.21 Make weld in 4G position with carbon steel [J36]		Goals 1, 3, 4	D15, E5	5
12.22 Identify gas tungsten arc welding problems, their causes and take corrective action [J33]	J33	Goals 1, 3, 4	D13, D15, E5	3, 5
12.23 Prepare gas tungsten arc weld for test [J34]	J34	Goals 1, 3, 4	D7, D15, D16, E5	3, 5
13. Plasma Arc Cutting				
*13.1 Demonstrate safety procedures for plasma arc cutting [K01]	K1	Goals 1, 2, 3, 4	D15, E5, H2, H4	2, 3, 4
*13.2 Describe theory of plasma cutting [K10]		Goals 1, 2	D15, E5	2, 3
*13.3 Set up and operate plasma cutting equipment [K02]	K2 (same)	Goals 1, 3, 4	D15, E5	3, 5
*13.4 Lay out and make straight line cuts [K03]	K3	Goals 1, 3, 4	D1, D2, D7, D15, E5	1, 3, 5
*13.5 Lay out and make bevel cuts [K04]	K4	Goals 1, 3, 4	D1, D2, D7, D15, E5	1, 3, 5
13.6 Lay out and make circular cuts [K05]	K5	Goals 1, 3, 4	D1, D2, D7, D15 E5	1, 3, 5
13.7 Lay out and make pattern cuts [K06]	K6	Goals 1, 3, 4	D1, D2, D7, D15, E5	1, 3, 5
13.8 Lay out, cut and bevel pipe to a 30-37 1/2 degree angle [K07]	K7	Goals 1, 3, 4	D1, D2, D7, D15, E5	1, 3, 5
*13.9 Lay out and cut square and round solid stock [K08]	K8	Goals 1, 3, 4	D1, D2, D7, D15, E5	1, 3, 5
14. Metallurgy and Heat Treating				
*14.1 Demonstrate safety procedures for metallurgy and heat treating [L01]	L1	Goals 1, 2, 3, 4	D15, E5, H2, H4	2, 3, 4
14.2 Identify the classification and physical properties of ferrous and nonferrous metals [L02]	L2 (same)	Goals 1, 2	D15, E5	3, 5
14.3 Identify and apply principles of preheating and postheating [L03]	L3 (same)	Goals 1, 2, 3, 4	D15, E5	3, 5
14.4 Describe and apply principles of metallurgy in annealing, hardening and tempering [L04]	L4 (same)	Goals 1, 2, 3, 4	D15, E5	3, 4, 5
14.5 Describe methods of testing metals [L05]	L5 (same)	Goals 1, 2, 3, 4	D15, E5	3, 4, 5
14.6 Identify types of ferrous metal by spark test [L06]	L6 (same)	Goals 1, 2, 3, 4	D15, E5	3, 5
14.7 Describe the relationship between the hardness test of weld, heat-affected zone	L7 (same)	Goals 1, 2, 3, 4	D15, E5	3, 5

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Missouri Competency	Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	VICA/SCANS Competencies
15. Carbon Arc Gouging				
*15.1 Demonstrate safety procedures for carbon arc gouging [M01]	M1	Goals 1,2, 3, 4	D15, E5, H2, H4	3, 4
15.2 Describe theory of carbon arc gouging [M04]		Goals 1, 2	D15, E5	3, 5
*15.3 Identify and select electrode size, polarity, current and air pressure [M05]	M2	Goals 1, 2, 3, 4	D15, E5	3, 5
15.4 Set up and operate carbon arc gouging equipment [M02]	M2	Goals 1, 3, 4	D13, D15, E5	2, 3, 4, 5
*15.5 Remove weld material/backgouge [M03]	M3	Goals 1, 3, 4	D15, E5	3, 4, 5
16. Visual Weld Testing				
*16.1 Prepare sample for visual test per appropriate standard [P01]		Goals 1, 3, 4	D7, D15, D16, E5	2, 3, 5
*16.2 Inspect for undercut, overlap, porosity, slag, spatter and weld size [P02]		Goals 1, 3, 4	D15, E5	2, 3, 4, 5
*16.3 Identify defects and take corrective action based on visual test [P03]		Goals 1, 3, 4	D15, E5	3, 4, 5
17. Destructive Testing				
17.1 Prepare coupon for bend test per appropriate standard [Q01]		Goals 1, 3, 4	D1, D2, D7, D15, D16, E5	2, 3, 5
17.2 Perform destructive test on weld [Q02]		Goals 1, 3, 4	D15, D16, E5	3, 4, 5
17.3 Identify defects and take corrective action based on destructive test [Q03]		Goals 1, 3, 4	D15, D16, E5	3, 4, 5
18. Non-Destructive Testing				
18.1 Prepare sample for non-destructive test per appropriate standard [R01]		Goals 1, 3, 4	D1, D2, D7, D15, D16, E5	2, 3, 5
18.2 Perform non-destructive test per appropriate standard [R02]		Goals 1, 3, 4	D15, D16, E5	3, 4, 5
18.3 Inspect for undercut, overlap, porosity, slag, spatter, and surface cracks [R03]		Goals 1, 4	D2, D13, D15, D16, E5	3, 4, 5
18.4 Identify defects and take corrective action based on non-destructive test [R04]		Goals 1, 3, 4	D13, D15, D16, E5	3, 4, 5
19. Leadership Competencies				
19.1 Demonstrate an understanding of VICA, its structure and activities [N01]	N1	Goal 1		
19.2 Demonstrate an understanding of one's personal values [N02]	N2	Goal 1		
19.3 Perform tasks related to effective personal management skills [N03]	N3	Goal 4	I4	
19.4 Demonstrate interpersonal skills [N04]	N4	Goal 2	I4	G1

Missouri Competency	Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	VICA/SCANS Competencies
19.5 Demonstrate etiquette and courtesy [N05]	N5	Goal 2	I4	
19.6 Demonstrate effectiveness in oral and written communication [N06]	N6	Goal 2		G1
19.7 Develop and maintain a code of professional ethics [N07]	N7	Goal 4		
19.8 Maintain a good professional appearance [N08]	N8	Goal 4	I5	F5
19.9 Perform basic tasks related to securing and terminating employment [N09]	N9	Goals 2, 4		
19.10 Perform basic parliamentary procedures in a group meeting [N10]	N10	Goals 2, 4		

AMERICAN WELDING SOCIETY
ENTRY-LEVEL WELDER PROGRAM OUTLINE, 1995

Source: *Guide for the Training and Qualification of Welding Personnel: Entry Level Welder (AWS EG2.0-95).* Miami: American Welding Society, 1995.

Course A: Occupational Orientation

1. Follow safe practices
2. Prepare time or job cards, reports or records
3. Perform housekeeping duties
4. Follow verbal instructions to complete work assignments
5. Follow written details to complete work assignments

Course B: Drawing and Welding Symbol Interpretation

1. Interpret basic elements of a drawing or sketch
2. Interpret welding symbol information
3. Fabricate parts from a drawing or sketch

Course C: Arc Welding Principles and Practices

Unit 1: Shielded Metal Arc Welding (SMAW)
1. Perform safety inspections of equipment and accessories
2. Make minor external repairs to equipment and accessories
3. Set up for shielded metal arc welding operations on plain carbon steel
4. Operate shielded metal arc welding equipment
5. Make fillet welds, all positions, on plain carbon steel
6. Make groove welds, all positions, on plain carbon steel
7. Perform 2G-3G limited thickness qualification tests on plain carbon steel plate

Unit 2: Gas Metal Arc Welding (GMAW, GMAW-S)
1. Perform safety inspections of equipment and accessories
2. Make minor external repairs to equipment and accessories
3. Set up for gas metal arc welding operations on plain carbon steel)
4. Operate gas metal arc welding equipment

Short circuit transfer
5. Make fillet welds, all positions, on plain carbon steel
6. Make groove welds, all positions, on plain carbon steel

Spray transfer
7. Make 1F-2F welds on plain carbon steel
8. Make 1G welds on plain carbon steel

Unit 3: Flux Cored Arc Welding (FCAW, FCAW-G)
1. Perform safety inspections of equipment and accessories
2. Make minor external repairs to equipment and accessories
3. Set up for flux cored arc welding operations on plain carbon steel
4. Operate flux cored arc welding equipment
5. Make fillet welds, all positions, on plain carbon steel
6. Make groove welds, all positions, on plain carbon steel

Unit 4: Gas Tungsten Arc Welding (GTAW)
1. Perform safety inspections of equipment and accessories
2. Make minor external repairs to equipment and accessories
3. Set up for gas tungsten arc welding operations on plain carbon steel, aluminum, and stainless steel
4. Operate gas tungsten arc welding equipment
5. Make fillet welds, all positions, on plain carbon steel
6. Make groove welds, all positions, on plain carbon steel
7. Make 1F - 2F welds on aluminum
8. Make 1G welds on aluminum
9. Make 1 F - 3F welds on stainless steel
10. Make 1G - 2G welds on stainless steel

Course D: Oxyfuel Gas Cutting Principles and Practices

Unit 1: Manual Oxyfuel Gas Cutting (OFC)

1. Perform safety inspections of equipment and accessories
2. Make minor external repairs to equipment and accessories
3. Set up for manual oxyfuel gas cutting operations on plain carbon steel
4. Operate manual oxyfuel cutting equipment
5. Perform straight cutting operations on plain carbon steel
6. Perform shape cutting operations on plain carbon steel
7. Perform bevel cutting operations on plain carbon steel
8. Remove weld metal from plain carbon steel using weld washing techniques

Unit 2: Machine Oxyfuel Gas Cutting (OFC)-[Track Burner]

1. Perform safety inspections of equipment and accessories
2. Make minor external repairs to equipment and accessories
3. Set up for machine oxyfuel gas cutting (track burner) operations on plain carbon steel
4. Operate machine oxyfuel gas cutting (track burner) equipment
5. Perform straight cutting operations on plain carbon steel
6. Perform bevel cutting operations on plain carbon steel

Course E: Arc Cutting Principles and Practices

Unit 1: Air Carbon Arc Cutting (CAC-A)

1. Perform safety inspections of equipment and accessories
2. Make minor external repairs to equipment and accessories
3. Set up for manual air carbon arc gouging and cutting operations on plain carbon steel
4. Operate manual air carbon arc cutting equipment
5. Perform metal removal operations on plain carbon steel

Unit 2: Plasma Arc Cutting (PAC)

1. Perform safety inspections of equipment and accessories
2. Make minor external repairs to equipment and accessories
3. Set up for manual plasma arc cutting operations on plain carbon steel, aluminum, and stainless steel
4. Operate manual plasma arc cutting equipment
5. Perform shape cutting operations on plain carbon steel, aluminum, and stainless steel

Course F: Welding Inspection and Testing Principles

1. Examine cut surfaces and edges of prepared base metal parts
2. Examine tack, intermediate layers, and completed welds

SHOW-ME STANDARDS

The new educational goals and standards are a result of the Outstanding Schools Act of 1993, which calls on Missouri citizens and educators . . . to define appropriate, rigorous expectations for children's learning. Committees of teachers, citizens, parents, lawmakers and state officials have been working on the proposed goals and standards since then.

To lead productive and fulfilling lives and to continue learning, students in Missouri public schools will acquire the knowledge and skills to:

Goal 1: Gather, analyze and apply information and ideas;

Goal 2: Communicate effectively within and beyond the classroom;

Goal 3: Recognize and solve problems; and

Goal 4: Make decisions and act as responsible members of society

Source: "The Show-Me Standards." Jefferson City, MO: Missouri Department of Elementary and Secondary Education, January 1996.

ALL ASPECTS OF THE INDUSTRY

Recent national legislation requires that vocational education programs provide a strong experience in "all aspects of the industry" (AAOI) for industries that students are preparing to enter. AAOI's ultimate goal is to give future workers a sense of the issues involved in the world of work. Such knowledge can empower future workers to make informed decisions about their career paths. This knowledge can also allow workers to make meaningful contributions to the industry, instead of performing mindlessly like another piece of equipment. The main areas of AAOI include:

- Planning
- Management
- Finance
- Technical and Production Skills
- Principles of Technology
- Labor and Community Issues
- Health/Safety/Environment
- Personal Conduct

Duty Bands and Objectives

A. Planning

- A1 Describe why industries respond to customer wants and expectations.
- A2 List differences in how companies deliver products versus delivering services.
- A3 Describe ways a worker can influence company decision-making.
- A4 Identify benefits in anticipating technology and market trend changes.
- A5 Identify an example of how regulatory laws can impact how a business operates.
- A6 Identify an example of how a political organization can impact how a company operates.

B. Management

- B1 Identify key components of a company "mission statement."
- B2 Identify how a corporate "chain of command" works.
- B3 Describe the significance of a company's "corporate culture."
- B4 Describe how a company organizes its departments.
- B5 List typical ways company departments communicate.
- B6 Cite examples of why a worker should adjust to different management styles.
- B7 Cite an example of how companies are dependent on the national economy.
- B8 Cite an example of how a company is dependent upon the local economy.
- B9 Describe the importance of achieving internal and external customer satisfaction.
- B10 Identify examples of how cultural diversity can affect an industry.
- B11 Identify key differences in how private companies and government agencies operate.
- B12 List reasons why written policies are used in industry.
- B13 Identify resources available from professional organizations.
- B14 Identify how roles and responsibilities in a family business are different than in larger companies.
- B15 List benefits a worker can get by participating in meetings.
- B16 List key differences in how a family farm operates versus how another small business operates.

B17 Describe how a company's marketing affects all its employees.

C. Finance

C1 List typical ways a business obtains capital.
C2 Describe the importance of accounting in a business.
C3 Describe key implications for a company which grants credit.
C4 Describe how a company estimates and bids for a contract.
C5 Describe how paycheck deductions affect a worker.
C6 Describe the importance of cost containment in a company.

D. Technical and Production Skills

D1 Demonstrate a basic math ability.
D2 Demonstrate the capability to measure quickly and accurately.
D3 Demonstrate the ability to speak and write the English language effectively.
D4 Demonstrate the ability to listen effectively.
D5 Demonstrate the ability to use effective negotiation skills.
D6 Demonstrate the ability to manage time effectively.
D7 Demonstrate the ability to read blueprints and drawings.
D8 Demonstrate the ability to perform basic computer operation.
D9 Describe the importance of deadlines and schedules.
D10 Demonstrate the ability to use team player skills.
D11 Demonstrate the ability to use supervisory and delegation skills.
D12 Demonstrate the ability to utilize good public speaking skills.
D13 Describe the importance of using troubleshooting techniques.

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D14 Cite one example of a job that is inter-related with another job.
D15 Demonstrate the ability to obtain technical information.
D16 Identify certification requirements for a specific job.

E. Principles of Technology

E1 Describe the key characteristics of the technology used in your industry.
E2 Describe the importance of analyzing new equipment for possible use.
E3 Describe the importance of continuously upgrading one's job skills.
E4 Describe the importance of adaptability and learning from experience.
E5 Describe the importance of acquiring and analyzing information effectively and making sound decisions.
E6 Describe the importance of cross-training.

F. Labor

F1 Describe the importance of a written job description.
F2 Describe the importance of knowing your rights as a worker.
F3 Describe the role labor organizations play in your industry (if any).
F4 List advantages/disadvantages of hourly and salaried pay.
F5 List differences between being a self-employed worker and a worker employed by a company.
F6 Describe the importance of participating in quality enhancement programs.
F7 Describe the importance of understanding why a worker is asked to occasionally work longer hours.
F8 Describe the importance of cultural sensitivity.

G. Community

G1 Describe the importance of recognizing a worker should contribute special skills through volunteer work.

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G2 Identify key ways a company helps its community.
G3 Identify key ways a community helps a company.
G4 Identify an impact of buying outside the community.
G5 Describe how a company's public perception is important.
G6 Describe the importance of providing for the access needs of the physically challenged.

H. Health, Safety and Environment

H1 Describe the importance of complying with federal agency regulations.
H2 Describe why it is important to avoid job-specific health threats.
H3 Read and comprehend major components of a Material Safety Data Sheet.
H4 Identify basic safety training (tornado, fire, first aid) techniques.
H5 Describe the importance of participating in preventive medicine programs.
H6 Describe the importance of handling stress effectively.
H7 Describe the importance of good workplace ergonomics.
H8 Identify any effects weather could have on an industry.
H9 Describe the importance of management's responsibility for a safe workplace.

I. Personal Conduct

I1 Describe the importance of recognizing the dignity of all work.
I2 Describe the importance of producing quality and effective work.
I3 Describe the importance of being fit for duty (no drugs, no alcohol).
I4 Describe the importance of exhibiting good attitude, enthusiasm, integrity.
I5 Describe the importance of exhibiting good grooming and appearance.
I6 Describe the importance of good personal financing.

Source: *All Aspects of the Industry (65-9000-I).* University of Missouri-Columbia: Instructional Materials Laboratory, 1994.

SCANS COMPETENCIES

SCANS *foundation skills* identified by the U.S. Department of Labor describe generic skills needed by nearly everyone. The SCANS *competencies*, however, are more specific in nature and are listed below. (SCANS is the acronym for the Secretary [of Labor]'s Commission on Achieving Necessary Skills.) National VICA's *Total Quality Curriculum* incorporates SCANS competencies and Total Quality Management (TQM) principles in a 17-module set of activities.

1. **Resources**
   - Allocates time
   - Allocates money
   - Allocates material and facility resources
   - Allocates human resources

2. **Interpersonal**
   - Participates as a member of a team
   - Teaches others
   - Serves clients/customers
   - Exercises leadership
   - Negotiates to arrive at a decision
   - Works with cultural diversity

3. **Information**
   - Acquires and evaluates information
   - Organizes and maintains information
   - Interprets and communicates information
   - Uses computers to process information

4. **Systems**
   - Understands systems
   - Monitors and corrects performance
   - Improves and designs systems

5. **Technology**
   - Selects technology
   - Applies technology to task
   - Maintains and troubleshoots equipment